THE

Practical Teacher

A MONTHLY EDUCATIONAL JOURNAL

Edited by JOSEPH HUGHES.

'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

VOL. III. No. 11. JANUARY, 1884. PRICE 6D. POST FREE, 7½D.

The Teacher's Health.

BY ALFRED CARPENTER, M.D. (LOND.), M.R.C.P. (LOND.), C.S.S. (CAMB.),

Vice-President of the British Medical Association.

THE VOICE.

THE acoustic properties of the voice can only be referred to as being a study of itself; but we may re-state with advantage that rapidity of motion is coincident with height of pitch. We have not space to distinguish between isochronous, periodic, rhythmic, or so-called musical sounds, and those which are called discordant, or to the differences between music and noise. Apparently they are not convertible terms, and yet music may be evolved out of noise by so arranging that the kinds of vibrations correspond, instead of being out of harmony. Neither have we space to describe the varieties of the human voice, but simply to name them: two may be said to belong to the male—viz., the bass and the tenor—and two to the female—the contralto and the soprano; but we occasionally find them transposed in the sexes, a female being bass and a male soprano, which transposition is not always pleasing. The difference in the shape of the resounding parts, and the capacity of the chest and larynx, in the sexes, leads to differences in the quality, intensity, and pitch of the voice, which differences are caused by alterations at different ages, so that after puberty there are distinctions which are not found in boys and girls. These come out as puberty approaches, and lead to alterations which are most marked in boys when they reach a certain age, and which change the capacity and character of the voice. The vocal organs in children are comparatively small, that is, comparing their volume with that of the whole body. As puberty is reached, they enlarge; there is a marked alteration in girls, but not to the same extent as in boys.

It should be an axiom with teachers that sustained vocal exercises should not be carried on whilst the voice is breaking and the accompanying alterations taking place. It is very important that this should be thoroughly understood. As soon as a child shows an alteration in the usual tones of his or her voice, there should be a cessation of systematic teaching and of continuous vocal exertion. Instruction in the distinction of tones cannot be commenced too young—it may begin as soon as a child understands the meaning of terms; but it must not be persevered in after the change of voice has commenced—at least as regards a sustained effort. In girls the change begins between twelve and thirteen, with boys between fourteen and sixteen, and is completed in one or two years. The pitch falls an octave or more in the latter, and any attempt to keep it up to its ordinary quality is likely to injure the organ and deprive it of its sensitiveness. When, therefore, a teacher perceives that a child's voice is changing, the lesson should be interrupted until the change is perfected; at least, as regards those lessons in which the capacity of the voice, its intensity, and its compass are brought into play. The child should not take part in any musical exercises beyond those of the simplest character. The ear may be instructed, but the vocal muscles must not be strained. These observations, from the doctor's point of view, have reference to the development and education of the organ of voice—to a so-called vocal culture. Professional vocalists who act as teachers do not always agree with these views, and much mischief results from ignorance regarding nerve and muscular development in cultivating the voice. The same kind of mischief arises in the cultivation of the organ of hearing, and in training for muscular contests in the playground, when these organs are used without judgment in excess of their powers. A teacher of music, who practises his artistic powers in opposition to the teachings of physiology, is sure to damage the health of his pupils. Teachers should get an anatomical knowledge of the organs of the voice, and some acquaintance with muscular power and development, which will tell them that the minute muscles of the larynx will not bear a long-continued action, such as assists to set up the very numerous vibrations required to produce musical sounds; they will be overstrained by the action. To harp too long on one string is sure to do mischief in the end, and when that string is a vocal chord the mischief may be irremediable. The pupil always has a tendency to copy his or her master's tones and actions. It is important that this should be borne in mind, and that whilst a woman may teach a child of both sexes, she cannot safely teach young men. For the same reasons it is not wise for a man to be

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entrusted with the cultivation of young women's voices; but men and women should only be taught by their own sex when vocal culture is the study. It is also necessary to recollect that the extreme delicacy of the organ of the voice requires continuous cultivation for continuous excellence. If a cricketer or violin-player is out of practice for a month, the loss of practice tells upon his power in the delicate use of his muscles; that loss is much more manifest in the vocal muscles than in the muscles of the arms and legs. Intermittent exercise is not productive of perfection when the intermission is for considerable intervals; exercise should be regular every day, and also nearly equal in amount. The vocalist must practise daily if he wishes to keep the voice in proper condition, so as to be able at will to bring out the extreme delicacy of tone which perfection demands. It is for this reason that amateurs do not, as a rule, equal professional vocalists in their capacity, their timbre, or their pitch. Persons who wish to excel in any one of the senses, whether it be touch, taste, hearing, or in delicacy of vocal exercises, must not use the part upon which sensitiveness depends in an improper manner. We may learn a lesson upon this point from the workhouse and the prison. If a man who depends upon the delicacy of his touch for a livelihood is set to pick oakum, or is sent into the stoneyard to break granite into small pieces, he soon loses his power to continue his occupation, say as a painter or printer; his delicacy of touch is lost by his change of occupation. The police easily detect the impostor who describes himself as that which he is not by an examination of his hands or his feet. The use of an organ in a given way affects the shape and the sensitiveness of the organ. That which applies to touch applies equally to vocal powers, and an improper use of the voice leads to changes in the tissues of the larynx, which show their effects to the end of life. The occupation of a man may be in some cases disclosed by his mode of speaking, as well as by the examination of his hands. Conventional and affected methods of speaking produce changes which are uncomfortable. The clergyman's throat has been already dealt with. It is not confined to the clergy, yet barristers and others who are constantly engaged in speaking for long periods together, do not suffer as a class, because they speak with their natural voice, and do not try to sustain a pitch which is unnatural to them. Costermongers, on the other hand, and those who use their voices at the highest possible pitch, are frequently subject to mischief in the organ.

If we watch the movements of the chest in vocalists, it will be found that those who use the abdominal muscles to the greatest extent are able to continue to use their vocal powers with the least fatigue and distress, whilst those who cause the upper part of the chest to expand whilst singing are most fatigued by their work. The inference which the teacher should draw from this fact is that everything which interferes with the descent of the diaphragm (that is, the muscle which separates the lungs from the stomach, liver, and other abdominal organs) should be discouraged. A hearty meal is an impediment to vocal endurance; so is flatus, which may arise from emptiness and indigestion; but that which interferes most with the performances of ladies, is the pernicious practice of wearing closely-fitting corsets, and the use of belts of all kinds round the waist. A female performer who has a tightly-fitting corset, or a band of any kind round her waist, is diminishing her excellence to the extent that such a mode of dressing has in preventing the descent of the diaphragm, and causing her to dilate the upper part of her chest. In such an one we see the collar-bones rise to a considerable extent. The muscles of the neck are brought into visible play, and the exertion of singing, and the fatigue which follows, is very much greater than in one who allows the diaphragm to descend, and uses abdominal respiration to a greater extent than the clavicular or collar-bone inflation. This is a point which the teacher should look to, and when clavicular elevation is distinct, she should draw the attention of the pupil to the fact, and cause her to alter her mode of dress, and to use the diaphragm instead of the muscles in the neck. I use the female term advisedly, because the evil is most prevalent among women, but it is not limited to that sex. Men and boys wear belts and tightly-fitting waistcoats, which interfere very much with continued vocal exertion. In former days the stocks which enveloped the throat, and the 'Masher' collars of the present era, have the same evil tendency. They are unnatural, and as such, must be injurious to humanity, especially to healthy, muscular growth.

Vocalists and orators should always be natural if they wish to excel. Imitation is a sustained effort, which will fail in its real object. Inspiration and expiration must be so managed as not to be forced. The position of the body must be easy, and no muscle of any kind put upon the stretch in positions which are not natural to it. Vocal gymnastics may be useful in overcoming defects of voice and tone, but they should be used under proper supervision, and for a special object. Singers in public are obliged to study time as a part of their education. Public speakers forget that time is necessary to enable the waves of sound to pass to all parts of a large assembly. Speakers, therefore, who speak in too high a key, or too loud in tone, or too fast, should pay some attention to vocal gymnastics if they are desirous to overcome their defects. Rapid speech does not give time for the hearers to understand the terms used. Vibrations succeed each other too fast for comprehension, and as a consequence there is inattention among the audience. The voice should not be much louder than that which is used in ordinary conversation, and the rapidity of utterance should be so managed that the larger the audience the further the waves of sound have to travel, and time must be allowed for their return before the next sentence is propelled into space.

The reflection from the walls and roof of the room throws the sound of the voice back among the audience, and there must be time for this reverberation to cease if the speaker is to command attention. The great difficulty in elocution is to be slow without appearing to be slow, to have a measured distinctness without absolute intervals of waiting for the next word.

We should not put an emphasis upon the consonants, and let the vowels slip out as if of no consequence; but a study of the defects of voice and speech is beyond our present scope.

The Mouth and Teeth.

Offensive breath, whether in teacher or pupil, is most disagreeable to the other. To have the smell of onions or of garlic, the odour of oxidizing alcohol, of stale to-

bacco, or the exhalation of sulphurous fumes, are each and all disagreeable enough. Offensive breath is produced by different causes. It may be due to constitutional defects quite unconnected with the condition of the teeth. There is a smell from some habitus in the breath, which is at times extremely disagreeable to the person affected, as well as to the bystanders, but as a rule the author of the smell is unaware of it.

When it is due to exhalation from the pulmonary membrane there is a defect in the blood, which requires to be put right. The defect is most prevalent amongst girls at the time of the monthly change which naturally belongs to them. It requires to be met by a blood purifier, such as a teaspoonful of the phosphate of soda taken daily, in a tumbler of water, and a brisk purge monthly, shortly before the flow begins.

Offensive breath is more usually connected with dental decay. Some of the teeth are carious; food is allowed to remain in the cavities until it putrefies, and sets up further mischief in the tooth itself, as well as in the general health of the individual. Such teeth will also have large quantities of so-called *tartar* gathered round their crowns, and by decomposition in the tartar, set up offensive miasms in the mouth, which eventually are felt by the subjects of it, though at first it is scarcely perceived by them. These conditions are such as ought not to be. We cannot always prevent the teeth from decaying, but we can prevent the decay of food in the hollow teeth, and we can prevent the formation of tartar around the crowns of the defective teeth. Tartar indicates the presence of living organisms in the mouth. It is an evidence of the existence of bacterial colonies—nests of living creatures in the mouth—which must be dislodged from their settlements before the mouth can be rendered pure again. The tartar must be scraped from the teeth, and the mouth washed out frequently with some antiseptic. A teaspoonful of Condy's fluid in a pint of water may be used several times a day. A solution of borax, a teaspoonful to half a pint of warm water, should be used occasionally, and the teeth carefully cleaned with animal charcoal. The charcoal should be pushed into the hollow teeth, and allowed to remain after the cleaning has been completed. It will arrest, change, and prevent smell from the decomposition which has taken place. Those who have offensive breath should cleanse the mouth after every meal; be careful to remove all particles of food from between the teeth, as well as out of the hollows. The colonies of bacteria will be soon destroyed by this process, especially if charcoal be used, and the breath will then be rendered sweet again. The bacteria act upon the food much as the yeast plant does in promoting alcoholic fermentation. The creature sets up a change in the food and saliva, multiplies itself immensely, separating the material at hand into gases, which smell, and into debris, some of which forms the tartar. The whole of the tenants must be completely dislodged from the mouth before a cure can be effected. This dislodgment can be only brought about by continuous attention to the mouth, and the daily use of charcoal or other similar disinfectants.

The teeth have a definite use; they are for the mastication of food, and their use promotes the secretion of saliva from the glands which are beneath the tongue and at the angle of the lower jaw.

(To be continued.)

Friedrich Fröbel.

BY HIS PUPIL, HEINRICH HOFFMAN.

VI.

Fröbel's slight acquaintance with languages had always been to him a matter of great regret. At Yverdun he felt it more acutely than ever, nor could he accommodate himself to the petrified, lifeless methods which in those days prevailed, more especially in the study of his native tongue.

Seeing, however, in languages another manifestation of the same fundamental laws which govern the whole universe, and anxious to secure to himself the connecting link between teaching and training, he now devoted himself with all the earnestness of his thoughtful mind to their study. Natural philosophy, his favourite science, stood to him in closest connection with languages—which, indeed, formed but 'one part of the physics of the mind.' He began with the Oriental languages. Hebrew and Arabic were to pave the way to the Hindostani and Persian; but he could not reconcile himself to the way in which the existing grammars dealt with the subject, and when he was told that the acquisition of the Oriental languages was, after all, but of little importance for his purpose, he dropped the Hebrew, and devoted himself to the Greek, which had for him an intense fascination. The year 1811 stands indelibly wrought in golden letters in the popular mind. It was the so-called 'comet year.' Fröbel delighted in long evening rambles. The starry heavens were to him a wonderful book of unfathomed wisdom, though as yet 'sealed sevenfold.' The appearance of the famous comet interested him deeply. His midnight meditations led him to a closer study of astronomy, and the law of the *sphere* soon engrossed all his thoughts, inasmuch as it seemed to him to be the long-sought primary law of all things created. Here he recognised the one absolute unity: 'all variety emanates from and rests in unity; the spherical represents variety in unity; all unity contains variety; it is unity and variety in the highest degree of completeness. All things created are of a spherical nature. Everything developes its spherical nature only by realising its character (being) in *itself*, in its *unity* and in its *variety*,'—trinity, he calls it. 'This development is the duty and the destiny of everything, as it is also that of man to develope, and to cultivate, his own individual nature.'

'He who labours for the development of the "spherical" nature in others may be said to educate them. Education is therefore *the development of the power of man, of his intuitions and of his intellect, in order to regulate his action.* In short, the spherical law is the primary law of the true and efficient education of man.' '*All life is a unity.*'

Years afterwards this philosophy became embodied in his collection of playthings and materials for infants' occupations, which begin with the ball as the one primary unity.

Another law, stern and irresistible, soon forced itself upon Fröbel's respectful and personal attention,—the iron law of necessity. His means were nearly exhausted, and he was already looking about for some literary occupation that might enable him to continue his academical studies, when, by the death of his aunt, he received a most opportune legacy.

In 1812 Fröbel left Göttingen for Berlin. On his

way he paid a visit to his brother Christian, the prosperous owner of an extensive weaving business, who lived in Osterode, in the Hartz. Here he spent his holidays in a very pleasant and mutually profitable manner. In Berlin he soon found an engagement in a far-famed educational institution, which was based on Pestalozzian principles, conducted by Herr Plamann—the same in which Prince Bismarck was educated. Fröbel's position in society was at once established. Berlin was then, as it is now, the seat of high intellectual and scientific culture. Men of world-wide reputation made the young university, founded three years before by Wilhelm v. Humboldt, the centre of German erudition. Fichte, Schleiermacher, Weisz and others revealed to Fröbel a new world of deep thought.

Among the teachers at Plamann's there was a man whose name will be for ever associated with the history of the German nation—'Old Father Jahn,' as he is familiarly called even now, the famous founder of the gymnastic movement, which was destined to spread so much terror among the dire foes of Germany, and, alas! also to alarm the despotism at home. He was one of the foremost to rouse all Germany against her arch-enemy; and when, in 1813, the whole nation rose against her oppressor, when everybody took part in the war of deliverance from an unbearable yoke, Fröbel could not but join the enthusiastic patriots, and, once more interrupting his studies, he entered upon a career which seemed utterly at variance with his own high aims.

Nor was it indeed patriotism alone that made him a soldier; in the letter addressed to the Duke of Meiningen he dwells to some length on the reasons that induced him to enter on that career.*

Three motives rendered it impossible to him to do otherwise. *As a German*, his heart was full of pious reverence for his native country, which he looked upon as something sacred and sublime. Secondly, as an *educator*, the idea horrified him that any able-bodied young man could be cowardly enough to forsake his country in such an hour of need; but how such a wretch could ever afterwards face his pupils without blushing, without exposing himself to their contemptuous taunts and sneers—how, in fact, he could ever attempt to inspire their souls with any grand and sublime idea that demanded self-sacrifice and devotion, or how he could ever think of educating children whose Fatherland he had shamefully betrayed, he was altogether at a loss to imagine.

In the third place, his feelings as a *philanthropist* urged him to assist with might and main in combating a great universal calamity, it being ignoble and unmanly to withhold his aid from the oppressed amidst whom he chanced to live. It will be easily conceived that neither politics nor military glory, nor even the allurements of exciting adventures, could find an echo in a heart that was full to overflowing with the highest ideal of philanthropy. So waiving all personal interests and all other feelings, he joined the famous volunteer brigade of Lützow—famous not so much on account of its military exploits as through Körner's spirited war-song, 'Lützows Wilde Jagd,' with its stirring musical composition, which even in the present day stands foremost among favourite war-songs in every province throughout Germany.

(To be continued.)

* It may be found in Dr. W. Lange's book, page 106.

Lessons in English.

BY ALEXANDER BAIN, LL.D.,

Author of "Education as a Science."

II.—THE DEFINITION OF POETRY.

THE present paper will illustrate the Definition of Poetry by a series of contrasts: namely, with Science, Oratory, Morality, and Religion.

To begin with Science.

So marked is the opposition of Poetry and Science, that an occasional overlapping of the two departments can never obscure it. The scientific expositor may introduce an ornamental illustration, like Plato frequently, such as would be in its place in a poem, but this does not make the science poetry. So there are in the wide domains of Science, genuine poetic effects, more especially of the grand and sublime, as in astronomy and cosmical philosophy; but the man of science is not therefore a poet. He does not aim at giving those effects, except as so much by-play, to relieve the hardness and the rigour of genuine scientific work. A great stroke of generalization like Newton's gravity is sublime and imposing; but such is not the primary intention of the scientific discoverer. The astronomer, geographer, geologist, mineralogist, botanist, zoologist, divide among them the whole field of the universe, apart from the human mind; but they relegate to the man of Art the bringing out of Artistic effects. The psychologist overtakes the region of mind; yet his handling does not lead him into poetry.

The only real confusion in this contrast arises from the overweening pretensions put forward by the poet, and by others on his behalf; as when it is said that he alone of men penetrates into the "central truth of things." Now the artist may be a very close observer of the face of nature and of the human mind; he may also be a bold generalizer, and may make guesses at hidden truth; but his drawbacks are,—that his observations have an æsthetic bias, that his generalities have the same, that he does not verify either the one or the other; and, worst of all, he states, without qualification, what needs to be qualified in order to be any way near the truth.

In the following lines, Pope is every sense a poet:—

> So Zembla's rocks (the beauteous work of frost)
> Rise white in air, and glitter o'er the coast;
> Pale suns, unfelt, at distance roll away,
> And on the impassive ice the lightnings play;
> Eternal snows the growing mass supply,
> Till the bright mountains prop th' incumbent sky:
> As Atlas fixed, each hoary pile appears,
> The gathered winter of a thousand years.

The next passage is merely science or doctrine in energetic phraseology compacted into verse:—

> For forms of government let fools contest,
> Whate'er is best administered *is* best.
> For modes of faith let graceless zealots fight,
> His can't be wrong whose life is in the right.

The definition of Poetry is put to a severer test in the contrast with Eloquence, Oratory, or the arts of Persuasion. Oratory has in all ages availed itself of the poetic style, and the poet often takes up an oratorical theme. In order to extricate this combination, we should secure beforehand a clear definition of Oratory. This, I think, is not very difficult. The meaning of Persuasion is influencing man to act or refrain from acting.

It extends beyond specific occasions to a general cultivation of the disposition; it is thus an instrument in our education as to our duties. It has its own means of working, apart from either science or poetry, but it often avails itself of both without becoming the one or the other. This is most easily shown in the case of science. The complications are more serious in the fusion of eloquence and poetry. We must approach the difficulty by guarded steps.

The main object of a poem, says Mr. Alfred Austin, is "*to move* and to please." It is from the same tendency to include active stimulation with pleasure proper, that Lyric Poetry is often regarded as the purest type. It often lends itself to oratorical occasions, and becomes a compound more effective, more rousing, than either oratory or poetry standing alone. Shelley is said by Principal Shairp to be greatest in his Lyrics, and the effect is attributed in part to his 'impassioned eloquence' in enforcing some sentiment or theme. Gray's *Bard* is the oratory of unmeasured denunciation, dressed in poetic garb. The splendid passage in the *Castle of Indolence*, commencing

> Ah! what avail the largest gift of heaven,
> When drooping health and spirits go amiss?
> How tasteless then whatever can be given?
> Health is the vital principle of bliss,
> And exercise of health. In proof of this,
> Behold the wretch, who slugs his life away,
> Soon swallow'd in disease's sad abyss;
> While he whom toil has braced, or manly play,
> Has light as air each limb, each thought as clear as day,

is a high order of persuasive address, to which the poetic arts lend their assistance.

Let us take a great orator like Chatham or Burke, whose staple is the usual arts of persuasion, both by argument and by appeal to the feelings. In argumentative oratory, there is as little poetry as there is in science; the cases are about a par. In what is called "Appeal to the Feelings," there is a good deal of ground common to the orator and the poet. To rouse indignation, for example, there must be a highly specific and concrete presentation of the circumstances; just as when the poet has to stir up the feeling of sublimity, or of pathos, or any other typical æsthetic feeling. Hence poets have supplied some exquisite examples of truly oratorical appeal; I need but cite the Mark Antony oration. That is, of course, viewed by us as a piece of poetry, and not improperly so, from the highly poetic arts employed in it. But it is also a fine example of what you might call imaginative oratory. Given the situation as conceived by the poet, the means are purposely adapted to the end. I am not sure that, in the actual situation, it would have been successful; I cannot say that the poet gauged the Roman mob, as one of their own orators would have done; for aught I know, his finest touches might have miscarried in the real encounter. This much, however, I venture to affirm, that it would be an enormous aid to any orator, to have one fourth of the poetic power shown in that passage.

In the other mode of introducing effects of Fine Art, namely, to lavish poetic figures, illustrations and pictures, the orator gains the attention and the favour of his audience by the pleasure that he thereby imparts; but, at the same time, he incurs a danger that we shall soon see more of; he is playing pleasantly on an instrument, and his hearers enjoy his performance and do nothing more. The most powerful oratory for practical influence works by *pain*, makes us uncomfortable until we do what the orator wishes; as when we are frightened with the prospect of bad consequences to ourselves, or when our sympathies are harrowed with the sufferings of others. Such was the Demosthenic oratory.

John Bright's famous utterance on the breaking out of the Russian war is a fine instance of poetry intensifying the effect of oratory, without appearing as poetry in the sense of pleasure or charm. In his speech, deprecating the war, Mr. Bright, adverting to the frightful loss of life that was inevitable, exclaimed—"The angel of death is among us," and amid the breathless silence of the House, he adds, "I can hear the rustling of his wings." The form of the innuendo was eminently poetical: but instead of operating in the poetic direction, of giving pleasure or relieving pain, it intensified tenfold the horror which his oratory aimed at producing—the horror of incurring the consequences of war.

Chatham's oratory could also supply such effects, as in the well-known passage on the tracking of the Indians with bloodhounds.

Compare these with Burke's fine, but fulsome, passage on the Queen of France, and we shall feel the difference. That passage is now looked upon as merely fine writing, poetry in prose, and it scarcely ever was anything else.

The realistic treatment of Death, by Young, is by unpoetical horrors, fit only for oratory.

> The knell, the shroud, the mattock, and the grave,
> The deep, damp vault, the darkness, and the worm.

Compare the redeeming softness of the "Angel of Death."

Mr. Gladstone defending the peace with the Boers, against those that would have had them more severely chastised previously — speaking, doubtless, in the presence of many who had relatives in our African regiments, exclaimed—"Would you first have more of your sons made to pass through the fire to Moloch?"

Holbein's *Dance of Death* is not more charged with realistic horror. If anything, it has the force of pictured eloquence.

But the illustration of this point is more pregnant in the next contrast that I have to work—Poetry and Morality. The poet is especially set before us as a great moral teacher; a position that I would wish to examine at some length, if I had not a more difficult contrast still waiting me.

Of the various ways that the poet can act as a moral teacher, I presume the chief is, his power to attract us by depicting high ideals of nobleness. A prose writer may do the same, but not with the same charm, and consequently with less efficacy. The serious question then comes—How far are men made better by such ideals? What success has ever attended them? This would involve a wide examination of ancient and modern poetry, and would probably end in nothing. For, in the first place, few poets depart sufficiently from the main object of poetry, which is undoubtedly pleasure, to study exclusively the moral improvement of their readers. They know the danger they run of being neglected, and this no poet can afford. They will provide striking pictures of goodness, which we all like to contemplate, provided we are not called upon to imitate it. Our natural tendency is to unite noble

ideals with ignoble practices; and I should say that, although now and then, we are caught hold of by an ideal, it is not so often from poetry, as from sober history, or still soberer observation of what passes before us. Moral teaching is strictly a branch of oratory, and may be helped out by poetry, but in the union the poetry may displace the oratory.

But perhaps the most pointed handling of this vast problem will consist in examining the pretensions of poetry in this direction, as stated by poets themselves and their critics. This I will take at a later stage.

The relation to RELIGION is one of the most serious and searching enquiries in regard to the Definition of Poetry.

In the endeavour to adorn whatever will adorn, poetry is checked only by incapability of being adorned. Now there are certain subjects that positively refuse poetical aid. Everything loathsome by nature; everything painfully useful; everything that inspires revulsions and horror from whatever cause; everything ignoble and contemptible,—must be left on one side. We admit pain on condition of its being redeemed by the poetic treatment, as in Tragedy. But there are horrors that we must suppose absolutely unredeemable. Butchery of human beings on the large scale:—the conquests of the Mongols, the exterminating wars of Rome, the Lisbon earthquake, the black hole of Calcutta, famines and plagues, and conflagrations, would seem beyond the scope of poetry. The Charge of the Six Hundred horse was redeemable in a partial degree: some would say wholly.

But what has all that to do with religion? Why this. If religion is staked upon the fall of man, with only a very limited and select redemption, according to a wide-spread belief not yet universally surrendered, the bare matter of fact therein implied is such a sum-total of horror—the incidents I have named being merely a few drops of an ocean—that it would seem infinitely beyond poetical treatment. Our, perhaps, too literal forefathers thought so; and the severer sects tried to divorce their religion from art in nearly every form. With them to escape from hell was a terrible matter of business; and although they could not exclude the poetic element, seeing that the Bible contains it, they did not regard Bible poetry with purely imaginative relish. They had a simple musical service; because human nature was unequal to sustain the agony of the severely business view of securing their salvation. Moreover, they could, after a certain severe ordeal, get something like assurance of being safe at last, and they were then in a position to indulge in the small round of permissible art-delights, although "taking their pleasures sadly," not to say grimly. It is a remark of Principal Shairp that the poetry of the Scotch is not religious; in other words their religion would not reconcile itself with poetry. They could take the two things in separation; but religion was business, and poetry was relaxation and amusement.

This position brings us at once face to face with Milton and Dante, the poets of religion in the full sense of the word; Milton will be enough for the present occasion. The *Paradise Lost* ventures to poetise the very fact that of all others we look upon as far beyond poetry. Well, but what does Milton do? He just recognises so much of the fact, and its incidents and consequences, as could be poetically redeemed, and keeps all the rest out of sight. He boldly sings of what brought "death into the world and all our woe"; but he does so, by dwelling in the region of vague generalities; and we do not take the trouble of resolving these into the particulars. We should not tolerate any one making a melodious poem out of our great mercantile disasters, or our catastrophes by flood and fire; yet any one of these multiplied a million times falls below the theme of the greatest poem in the language.

How lightly Milton could regard the stern reality that underlies his gorgeous descriptions, is best shown when he comes to the tremendous moment of eating the apple.

On Eve's transgression:—

> So saying, her rash hand in evil hour
> Forth-reaching to the fruit, she plucked, she eat:
> Earth felt the wound, and Nature from her seat,
> Sighing through all her works, gave signs of woe
> That all was lost.

Next, on Adam's fall:—

> Earth trembled from her entrails, as again
> In pangs, and Nature gave a second groan;
> Sky loured, and muttering thunder, some sad drops
> Wept at completing of the mortal sin
> Original.

I venture to think that, in these passages, there is not merely theological levity; there is also poetical inadequacy. The poet did not even regard the occasion as demanding his highest stretch of tragic embodiment. Something ten times as powerful as the picture of Sin and Death was the least that could approach the awfulness of the situations. Or one of Shakespeare's still more energetic flights—something on a level with the Macbeth passage—

> Though you untie the winds, and let them fight
> Against the churches:—though the treasure
> Of Nature's germins tumble all together,
> Even till destruction sickens:—

should have been attempted with a view to cope with the magnitude of the calamity.

It would seem, then, that in proportion as religion takes the form of art in its purest type, it departs from the severity of dogma as embodied in our prevailing creeds. If it be said that poetry is a softening influence, the question arises, is the softening a sacrifice of the truth? Poetry *could* lend itself to expressing the rigours of the creed; to make the painful side more painfully felt: a function that we have already reviewed in connection with eloquence. A certain amount of this effect could be exemplified from Dante; not so much from Milton, who generally redeems, like a true poet, the horrors that he creates, or keeps out of sight what he cannot redeem.

The treatment, in *Paradise Lost*, of the great tragedy of the human race, suggests very serious reflections, which will assume in the future greater and greater importance. It raises the question how far a poetical religion is religion at all: whether religion is not deprived of reality and made an affair purely of ideality, or imagination; whether, in fact, it be not rendered mythical. In Milton's poem, Paganism and Christianity are about equally turned to account; a stranger to our past history might not be able to say which he really believed; or, indeed, whether belief was any part of the case.

If, then, it is asked whether religion is a fit subject

for poetry, the question must be asked in return—What religion? Some religions, such as the ancient Greek polytheism, have been susceptible of poetical treatment: the Calvinism of Jonathan Edwards seems very much the reverse. It is a question of degree and compromise. Religion, in its own distinctive character, as our relation of obedience to a supernatural power, is not at all poetical to begin with. When, however, we establish a ritual of worship, as well as a scheme of doctrine, we have a groundwork of artistic adornment, and may carry that out according to our feeling and taste: the scope increasing, as we think less and less of the severe obedience-relation and its duties and responsibilities.

I pass for a moment to a recent example of the poetry of religion, or rather of no-religion—the poem of Tennyson, in the *Nineteenth Century*, entitled DESPAIR. I think this a specimen of unredeemed horrors: and, altogether unjustifiable, as a poem. It ought to be regarded as a tremendous polemic, on the side of Belief, by means of an *argumentum ad hominem*, enforced by poetic arts; not, indeed, the arts that enable poetry to delight, cheer, and soothe us, but the arts that give to oratory a more terrific sting. My contention is that when poetry abandons the object of all Art (as I conceive it), to elevate, instead of depressing our mental tone, it has deserted its vocation, and embraced some other. I will not deny its services in that new vocation, but they are not poetic services. In poetry, we must make our stand by the law of pleasure, if the forms of composition are to be kept apart, each under its distinctive banner.

(*To be continued.*)

—o—

Lessons in Latin.

BY THE REV. A. D. CAPEL, M.A., CANTAB.,

Formerly Examiner of Schools to Cambridge Local Examinations Syndicate.

KEY TO EXERCISES.

EXERCISE 38.

A.

1. Under him Rome had 83,000 (of) heads of Roman citizens, together with those, who were in the fields. 2. He conquered the Volsci, which nation is not far from the city. 3. And the people determined that they should hold power for one year, that they might always be civil. 4. There were, therefore, in the first year five consuls. 5. But Lartius was the first Dictator at Rome. 6. When I was at Rome I saw Cicero. 7. Ye were in the city to see the sights. 8. After it he took Falisci also, a no less noble city. 9. No one will be always good. 10. You have been happy because you have been good.

B.

1. Tusculum cepit, quæ civitas longe ab urbe non est. 2. Beatus es quia es bonus. 3. Atque hic secundus post Tarquinium fuit, qui dux contra patriam suam esset. 4. Hic locus urbis erit, requies ea certa laborum. 5. Tempus erat, quo prima requies mortalibus incipit. 6. Nullus hostis fuit intra Italiam qui Romanam virtutem magis fatigaverit (perf. sub.) 7. Servus beatus erit. 8. Fuisses minus nobilis. 9. Certus sit. 10. Mea urbs a tua longe non erit.

EXERCISE 39.

A.

1. They laded the ships about to depart with corn. 2. You laid waste the captured city with a great fire. 3. The State is about to adorn (its) temples with images of the gods. 4. The desire for lost riches is great. 5. The consuls being sent against the Africans, destroyed them in great battles. 6. Having been received in heaven on account of his valour, he turns away (his) eyes. 7. Whether this is unsuitable, or to be praised, he (viz., Æsop) found (them) out; our hand perfected them. 8. He returned at the hour named. 9. Pompey having been conquered by Cæsar, directed his fleet to the Island (of) Cyprus. 10. The Roman people rose at the verses of Virgil being heard in the theatre.

B.

1. Sol oriturus, lucem suam in terram nocte consopitam effundit. 2. Calvi momordit musca nudatum caput. 3. Male mulcatus graculus redire cœpit ad proprium genus. 4. Vix hæc ediderat, cum effusis imbribus atra tempestas furit. 5. Hae sunt divitiæ certæ, semper permansuræ. 6. Elephanti equitatu circumventi infirmos in medium agmen recipiunt. 7. Nos aquaturi ad flumen veniemus. 8. Vos ab hostibus vulnerati dolorem sentietis. 9. Aliud est puellas rapere, aliud cum viris pugnare. 10. Dux, exercitum in prælium ducturus, morbo periit.

EXERCISE 40.

A.

1. The princes themselves kiss that hand by which they have been oppressed. 2. What will you do to yourself, who have added insult to injury? 3. Now favour holds their minds, and about to laugh, not to look, they sit down. 4. To whom have you given this? 5. He, suddenly frightened by the shout of the enemy, was persuading the ass to fly. 6. I hate that man. 7. What end of our labours, great king, do you give? 8. Which miserable things I myself saw, and of which I was a great part. 9. Alas! what land now, says he, or what now at last remains for me miserable.

B.

1. O lux Dardaniæ, quæ tantæ tenuerunt moræ? 2. Quæ causa indigna tuos fædavit vultus, aut cur hæc vulnera cerno? 3. Vidi ipse Neoptolemum. 4. Vidi Priamum sanguine fædantem, quos ipse sacraverat, ignes. 5. Nate, quis indomitas tantus dolor excitat iras? 6. Nam quid consilium aut quæ jam fortuna dabatur? 7. Quem non incusavi hominumque deorumque? 8. Simul me ipsa silentia terrent. 9. Quid non mortalia pectora cogis, auri sacra fames?

LESSON XLI.

SUBSTITUTES FOR PERFECT ACTIVE PARTICIPLE ABLATIVE ABSOLUTE.

310. The English perfect active participle, as 'having spoken,' is very common; but, as has been said in Lesson XXXIX., there is no single Latin expression which corresponds to it.

311. The Latins sometimes used 'quum' with the pluperfect subjunctive; as 'quum dixisset,' 'having

spoken,' or a grammatical figure we English use very little, viz., the absolute case.

312. In Latin, when a noun and an adjective (or a participle) stand *independently* of the sentence, they are put into the ablative case, and are called 'ablative absolute.' When we English use an absolute case, we employ the nominative, as, 'I being there, Cæsar spoke.'

313. If then we have to translate into Latin, 'The Gauls, having stormed Rome, returned,' we may either say, 'The Gauls, Rome having been stormed, returned' (putting 'Rome' and 'stormed' into the ablative case), or, 'The Gauls, when they might have stormed (English, had stormed) Rome, returned.' 'Rome having been stormed' is entirely independent of the sentence 'The Gauls returned' and is said to govern itself; hence the term 'absolute.'

314. The ablative absolute is one of the commonest figures used in the Latin language, and must be thoroughly mastered. In translating Latin into English, it is better to use the perfect participle or a conjunction and a finite mood—*e.g.*, 'Brutus, me vivo, periit'; 'Brutus died whilst I was alive.' 'Hannibal hostibus occisis, ad Africam rediit;' 'Hannibal, having slain his enemies, returned to Africa.'

315. VOCABULARY 41.

English.	*Latin.*		*Eng. Deriv.*
To enter upon (of a battle)	Committĕre	P. R. Commīs 3rd R.	Commiss.
Help	Auxilium	G. Auxilii	Auxiliary
	m. *f.* *n.*		
Only	Unicus -ca -cum	R. Unic.	
Greatest	Summus -ma -mum	R. Summ.	Sum.
Dead	Defunctus -ta -tum	R. Defunct.	
Wherefore	Quare, a conj.		
Dowry	Dos	G. Dōtis	
Youth	Juvenis	G. Juvenis	Juvenile
Piety	Pietas	G. Pietātis.	Piety
Hope	Spes	G. Spei (E. decl.)	Despair
To restrain	Coercĕre	R. Coerc.	Coercion
Pyre (funeral)	Rogus	G. Rogi	
Young man	Adolescens	G. Adolescentis (Exc. I.)	Adolescent
Forthwith	Prōtinus, an adverb		
Senate house	Curia	G. Curiæ	
Office	Munus	G. Munĕris, n. g.	
Business	Negotium	G. Negotii, n. g.	Negotiate
Earnestly	Strenue, an adverb		
To apply oneself to	Obīre	P. R. Obi. 3rd R.	Obit
A painted panel	Tabula	G. Tabulæ	
A picture			
To adorn (much)	Exornare	R. Exorn.	
Booty	Manubiæ	G. Manubiarum (no sing.)	
Use	Usus	G. Usūs	
Whence	Unde, an adverb		
To turn	Convertere	P. P. Convert, P. R. Convers	
To decree	Decernĕre	P. R. Decrēvi 3rd R.	Decrēt.
To found	Condĕre	P. R. Condid. 3rd R.	Condit.
Multitude	Multitūdo	G. Multitūdinis, f. g.	
Sight	Conspectus	G. Conspectūs	
Twenty-five	Viginti quinque, indeclinable		
To approach	Accēdĕre	P. R. Access 3rd R.	Access.
As far as	Usque, an adverb		
To offer	Offerre	P. R. Obtūl. 3rd R.	Oblāt.
To advance	Prōcēdo	P. R. Process. 3rd R.	Process.
Helmet	Gălea	G. Gălew	
Occasion	Occāsio	G. Occasionis.	
To find (after looking)	Rĕpĕrire	P. R. Reper. 3rd R.	Repert.
To destroy (utterly)	Delĕre	R. Delev. 3rd R.	Delet.
To advance	Pergĕre	P. R. Perrex. 3rd R.	Perrect.
To join	Jungĕre		
Iron	Ferrum	G. Ferri	
Ambassador	Lēgatus	G. Legati	Legate
To discover	Cognoscĕre	P. R. Cognov. 3rd R.	Cognot.
Poor			
To promise	Promittere	P. R. Promīs 3rd R.	Promiss.
Fourth	Quartus -ta -tum	R. Quart.	Quartern
Kingdom	Regnum	G. Regni., n. g.	
To beg	Sollicitare	R. Solicit.	Solicitor
To come over To across	Transire	P. R. Transi. 3rd R.	Transit

EXERCISE 41.

316. 1. Pugna (26) commissa, Pyrrhus auxilio elephantorum (35) vicit (23). 2. Quintus Marcius Consul (17), quum filium (7) unicum, juvenem summæ pietatis et magnæ (20) spei (genitives of description), morte (8) amisisset (20) dolorem (39) suum (20) ita (17) coercuit, ut a rogo adolescentis protinus curiam peteret (9) ibique (28, 16) muneris sui (20) negotia strenue obiret. 3. Lucius Mummius qui (27), Corintho (exc. fem.) captâ, (26) totam (31) Italiam tabulis statuisque (29) exornavit, ex (26) tantis (40) manubiis nihil (31) in (Eng., for) suum (20) usum convertit, ita (17) ut, eo (37) defuncto, non esset (38) unde ejus (37) filia (7) dotem acciperet (28). 4. Quare senatus (19) ei (37) ex (26) publico (Eng., 'treasury') dotem decrevit. 5. Conditâ civitate, quam (27) ex (26) nomine (20) suo (20) Roman vocavit (11) multitudinem finitimorum (14) in civitatem (14) recepit (29). 6. Et quum, orta subito tempestate, non comparuisset, ad deos transisse (to have gone) creditus est (he was believed), et consecratus (esse) (to have been deified).

B.

In the first four sentences translate the perf. act. participle by 'quum' with plup. sub., in others translate it by abl. ab

1. For (40) his (not 'suus') (37) son (7) having injured (injuriâ afficĕre, P. R. affēc) the wife (9) of Collatinus, she (37) killed (30) herself (35) in the sight of all (20). 2. And ('que' appended) having reigned (4) twenty-five years (acc. 20) (17) he fled (27) with (20) (his) wife (9) and his children (11). 3. Having often (35) conquered (23) the Romans he approached as far as to (10) the city (7). 4. Then (20) Marcus Valerius, a tribune (17) of the soldiers (6), offered himself (35), and having advanced armed (2), a crow (18) sat (37) on his (dat. of is) helmet. 5. He (ille), having found an occasion, fought (20) most successfully (felicissime) and destroyed the Samnites (Acc. -tas) (utterly), afterwards (16) Pyrrhus, (20) having joined the Samnites (I decl.) to himself (35), advanced (to) Rome, and (atque) (33) laid waste (18) all (25) things with sword (lit. iron) and (que) fire (13). 7. He admired (admiratus est) Fabricius, one (31) of (26) the Roman (20) ambassadors, (ut) when (13) he had discovered (plup. sub.) him (35) to be poor, having promised (him) a fourth part (1) of (his) kingdom, begged (perf. sub.) (him) to come over to him (see 270).

LESSON XLII.

PRESENT ACTIVE AND FUTURE PASSIVE PARTICIPLES.

317. The present participle is formed from the present root, and ends in 'ns,' preceded by the characteristic vowels (writing 'ie' for 'i), thus:—

a	e	ĕ	i
ans	ens	ens	iens

The English of it ends in 'ing.'

318. The present participle of neuter verbs is really an adjective, as 'oriens,' 'rising.'

319. The Future Pass. Participle is also formed from the Pres. Root, by adding 'ndus,' preceded by characteristic vowels, (writing 'ie,' for 'i,') so that we have—

a	e	ĕ	i
andus	endus	endus	iendus

The English is 'about to be —d,' or 'to be —d,' or very often 'must be —d.'

320. Whilst these Future Passive Participles are declined like O and A adjectives, Present Participles are exceptional I nouns (Root found by changing 's' into 't'), so that the gen. plur. is 'amantium,' and not 'amantum,' according to rule in 98. The neut n., ac., and voc. pl. of these words end in 'ia.'

321. There is an idiomatic use of the Fut. Pass. Participle, which will be discussed in a future lesson.

322. VOCABULARY 42.

English.	*Latin.*		*Eng. Deriv.*
To enter	Intrāre	R. Intr.	Introit.
Bedroom	Cubiculum	G. Cubiculi	Cubicle.
To catch (find)	Dēprĕhendĕre	P. R. Deprehend. 3rd R.	Deprehens.
To inhabit / To cultivate	Incolĕre	P. R. Incolu. 3rd R.	Incult.
Bridge	Pons	G. Pontis.	
Make	Fabricāre	R. Fabric	Fabrication.
To destroy	Afficere	P. R. Affec. 3rd R.	Affect.
Slaughter	Cladēs	G. Cladis.	
Blind / Dark	Cæcus	R. Cæc.	
To confine	Cōhĭbĕre	R. Cohib.	
Cave	Spēlūnca	G. Speluncæ.	
Hiding place	Lātĕbra	G. Lātĕbræ.	
To thrust forth	Exsertāre	R. Exsert.	
Rock	Saxum	G. Saxi, n. g.	
Between	Inter, a prep. gov. acc. case.		
Charioteer	Auriga	G. Aurigæ.	
Over / Above	Super, prep. gov. acc. case.		
Chariot	Carpentum	G. Carpenti, n. g.	
To drive	Agĕre		
To defend	Dēfendere	P. R. Defend. 3rd R.	Defens.
To destroy	Dīruĕre	P. R. Dīru. 3rd R.	Dirūtum.
Goat (she)	Capra	G. Capræ.	
To stand	Stare	P. R. Stet. 3rd R.	Stat.
Shallow water	Vadum	G. Vadi	To wade.
To go round	Circumire	P. R. Circumi. 3rd R.	Circumit.
To take up	Tollĕre	P. R. Sustŭl. 3rd R.	Sublat.
To strive after	Appetere	P. R. Appeti. 3rd R.	Appetit.
Pay	Merces	G. Mercēdis.	
To leap	Sālire	No P. R. 3rd R.	Sālitum.
Strength	Vires	G. Virium (pl. of vis).	
To depart	Discēdĕre	P. R. Discess. 3rd R.	Discess.
	(Note this word is misprinted in Voc. 31.)		
Not yet	Nondum, an adverb.		
Ripe	Mātūrus -ra -rum	R. Matur	Mature.
A little fox	Vulpēcŭla	G. Vulpeculæ.	
To touch	Tangĕre	P. R. Tetig. 3rd R.	Tact.
To get out of	Evadere	P. R. Evas. 3rd R.	Evas.
Well	Puteum	G. Putei.	
Goat (he)	Hircus	G. Hirci	Hircine.
To thirst	Sītīre	R. Sitiv. No 3rd R.	
To come down	Dēvĕnīre	P. R. Deven. No 3rd R.	
At the same time	Sīmŭl, adverb.		
To reprove	Objurgāre	R. Objurg.	
Fluid	Liquor	Liquoris	Liquid.
Victor	Victor	G. Victoris	Victoria.
To fall into	Decidere	P. R. Decid. No 3rd R.	
Horn	Cornu	G. Cornūs	Cornucopia.
To stick	Hærĕre	P. R. Hæs	Hæs.

323. EXERCISE 42.

A.

1. Ut (when) intravimus Catonis cubiculum, ipsum (40) sedentem (40) et librum (6) intra (30) manus (8) tenentem (18) deprehendimus. 2. Cæsar Germanos trans (12) Rhenum (R. Rhine) incolentes primus (20) Romanorum, ponte fabricato, aggressus (having attacked) magnis (20) affecit cladibus. 3. At (35) Scyllam cæcis cohibet spelunca latebris Ora (30) exsertantem, et naves (9) in saxa trahentem (26)V. 4. Scan these two hexameter lines, 2nd line beginning at 'Ora.' 5. Romani inter ipsos (40) ludos (23) spectantes (40) virgines (14) rapuerunt (39). 6. Quum (13) domum (1) rediret (27) aurigam super patris (14) corpus (15) in via (11) jacens (13) carpentum agere jussit (29). 7. Is (37) hanc (37) urbem (7) a (39) civibus (8) defensam (20) cepit (26) ac (33) diruit. 8. Pueri (7) docendi (3) sunt (38), ut sapiant (6). 9. Lupus (8) capram in altā (20) rupe (37) stantem vidit (27).

B.

1. Girls (8) must be taught (3) that they may be wise (6). 2. Tullus Hostilius reigning (4), the Romans took up (Eng.) war (16) with (20) the Albans (Albanus). 3. Being compelled (40) by hunger (40), a fox (8) was striving after a bunch of grapes (7) on a high (20) tree (1), leaping with great (20) strength. 4. And (part. of 'qui') when (Lat. 'ut') he was not able (L. potuit) to touch it (prop. case and gen. of 'qui') departing he says (L. ait) it is not yet ripe. 5. A little fox having fallen ('quum' with plpf. sub.) into a well, a goat, thirsting, came down to ('in' with acc.) the same (37) place (9). 6. At-the-same-time he asked (19) whether (L. au) the fluid was (imp. sub.) sweet (29). 7. She (use 'ille') answered (18), Descend (14), (my) friend (5), the water (2) is very-good (L. optima). 8. Then (20) the little-fox got-out-of the well, having-supported (L. nixa) (herself) (on) (his) high (20) horns and (que) left (20) the goat sticking in the enclosed (proper part. of 'claudĕre') shallow-water. 9. Simonides began (37) to go round the noble (38) cities (7) of Asia, having received (28) pay (abl. ab), singing (30) the praise (22) of the victors. 10. Then (20) the huntsmen (27), grieving (3), reproved (imperf.) the dog (14).

(To be continued.)

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The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

IN last month's issue of this magazine the reader will find the reproduction of a lesson upon 'The Work of Ice.' I propose in this article to give the subject-matter of the remaining lessons for Standard II. It must be borne in mind that the aim with these little children is simply to excite the mind to correct observation of such operations of nature as occur in one's ordinary daily experience; and that this end is to be attained by means of easy conversational lessons.

Following 'The Work of Ice' we have—

THE WORK OF THE WIND—1. WINDMILLS.

(Objects exhibited:—Picture of windmill, exterior and interior. A toy, with wooden frame on which are paper flaps; the frame made to revolve when blown upon.)

Wind, the movement of air from one place to another, the work of the sun, as previously explained. Recapitulate this. But wind itself does work, *i.e.*, turning windmills. Carry on a conversation about the picture: revolving sails; show, and let a boy work the toy; instance sails of a ship. Note POSITION of mill, on a hill, to catch the wind. STRUCTURE of upper part of mill, *i.e.*, to turn to windward; compare the shifting of sails of a ship. Interior of mill. Work done. Old method of grinding corn.

(*Note*,—If the school is in a rural district, two or three lessons can be made of this.)

THE WORK OF THE WIND (*cont.*)—2. SAILING VESSELS.

(Objects exhibited: Pictures of a ship in full sail; of ship 'tacking'; of ship in a gale; and of a horse drawing a barge.)

Horse in picture doing 'work.' So the wind in the picture is doing 'work,' *i.e.*, driving the ship before it. Sails are sheets to catch the wind; names of two or three. Sails not fixed: can be turned to the wind—instance upper part of windmill as described in last lesson. The ship sails (1) direct *with* the wind, or (2) partly against wind by 'tacking'; explain 'larboard' (left side) and 'starboard' (right side) of a ship. Larboard tack, *i.e.*, wind from the left; ship steering to the right. Starboard tack, *i.e.*, wind from the right, and ship steering to the left. (3) Quite 'in the teeth of the wind.'

(*Note.*—If the school is in a sea-port town, better make three lessons of this.)

THE WORK OF THE WIND (*cont.*)—3. CARRYING CLOUDS, SHIFTING SAND, ETC.

(Objects exhibited:—Pictures of cloud scenery; of sandstorm, etc.)

Wind bears along clouds: vapour rises from the ocean, etc., into the air; this is the work of the sun, as before explained. Great clouds of vapour borne from over the sea to the land, to fall as rain. In England a west or south-west wind brings rain, explain why. East wind—dry; reason of this. Dry wind, not good.

'When the wind is in the east
'Tis neither good for man or beast.'

Wind raises sand, and carries it away to another place: instance parts of Egypt buried under sand from sandy deserts. Sand cliffs worn away by the wind.

THE WORK OF HEAT—1. CHANGING SOLIDS TO LIQUIDS, ETC.

(Objects exhibited:—Pictures of blast furnace, and of steam engine.)

(1) Converts solids to liquids. Smelting of ores. 'Batch,' *i.e.*, a mixture of white sand, soda, pearlash, red lead, etc., converted to liquid glass in the furnace. Bearings of machinery sometimes 'set' or fixed by over-heating. Soldering, lead melting, etc.

(2) Converts liquids to vapours or gases. Heat some water and show this. Steam occupies 1700 times as much space as the water from which it was formed. Carry on conversation about steam and the steam engine; show the fire, boiler, cylinder, etc. Melt some sulphur to a liquid, then to a vapour. Show that iodine passes at once from a solid to a vapour.

WORK OF HEAT (*cont.*)—2. EXPANSION OF SOLIDS, LIQUIDS, AND GASES.

(Objects exhibited:—Picture of a wheelwright's yard. Apparatus consisting of a brass plate with a circular hole, through which a metal ball *just* passes. Glass beakers, etc.)

(1) Expansion of solids. Show apparatus; let the ball pass through the hole; then *heat* the ball in the flame of a spirit lamp, then it will not pass through. Explain why. Show picture of men putting on iron tyres to wheels; riveting boiler-plates with red-hot rivets. Show how to remove a glass stopper that has become fixed in a bottle.

(2) Expansion of liquids by heat. Kettle not quite full of cold water; when water gets warm, it begins to run over. Why? Fill a glass beaker with water; throw in a little sawdust; apply the flame of the spirit lamp, and note how the heat sets up an upward current; reason of this.

(3) Expansion of air or gases by heat. Make a paper balloon, and let it up, as previously explained; or nearly fill a paper flour-bag with air, then hold it in front of the fire; bag swells. Why?

(*Note.*—This subject may be expanded into three lessons.)

THE WORK OF VEGETATION—1. FORMATION OF STARCH, SUGAR, GUM, ETC.

(Objects exhibited:—Picture of cornfield; of orchard. Apparatus for the separation of starch, etc., from wheat-flour, or from the potato. *Note.*—This apparatus is figured and explained in 'Hughes's Science Reader,' No. 2.)

Animals feed upon vegetables, and vegetables upon minerals. (There are, of course, exceptions to this general statement. But it expresses a truth sufficient for our present purpose.) Plants work up raw mineral materials into food-stuffs for animals. Animals could not live upon mineral substances. Show the separation of starch from wheat-flour; and the special character of the gluten that remains. Also get starch from the potato, and test with iodine water. Show piece of sugar-cane; gum from cherry or plum-tree, etc.

Hence the work of vegetation, *i.e.*, the formation of organic compounds.

THE WORK OF VEGETATION (*cont.*)—2. SUPPLY OF GOOD AIR.

(Objects exhibited:—Picture of country scene, and of seaweed in water. Apparatus for breathing into lime-water.)

Man and other animals by breathing render the air bad. Show that our outward breath differs from our inward. (Two Woulff's bottles and some glass tubing could be so arranged as to show this clearly. Let the inspired air pass through the lime-water of one bottle, and the expired air through that of the other. Only the lime-water in the latter is affected.) Leaves and other parts of plants take in bad air and give us good air. This is a most useful work. (At present, better not use the terms oxygen, carbon dioxide, etc.) Use of ventilation and cleanliness.

Fish and other water-breathing animals use up the good air in water and give out bad. Water-plants take in this bad air, and give out good. Hence the reason for often changing the water in fish-globes; or else allowing water-plants to grow in it. Watercress with its roots will do well for this, especially in the case of gold and silver fish.

This completes the course of lessons in Elementary Science so far as Standard II. is concerned. I have this week been examining a second standard of about one hundred boys, who have gone nearly through the syllabus presented in these articles. The division has been under the care of an intelligent teacher. I had

the lads out in groups of six at a time and tested them individually, the plan which, I presume, will be adopted by the Inspector. Only twelve in the whole division failed to answer the questions. It was remarkable how differently the boys regarded *this* subject from the others. I had been examining in arithmetic; and when I said, 'Now I will see what you know of elementary science,' the faces brightened up as though something very pleasing was about to happen. The interest shown was certainly such as I have never seen displayed in any other subject. Also the indirect effect on the general intelligence of the boys was manifest. The reading was more expressive. The answers in grammar were less mechanical. In short, there is no doubt whatever, that as an educative agent, this subject is far more valuable than geography, which, for the second standard certainly, is mainly a question of verbal definition.

(*To be continued.*)

—o—

Science Notes.

ASTRONOMY AT CAMBRIDGE.—Mr. Andrew Graham, First Assistant to the Professor of Astronomy at Cambridge Observatory, has been presented for the complete degree of M.A. honoris causâ; he discovered the ninth minor planet Metis, a fact elegantly referred to by Mr. J. E. Sandys, the Public Orator.

* * * * *

POWDERED ASBESTOS.—M. Erichsen, of Copenhagen, has prepared a special enamel by mixing powdered asbestos with soluble salts, such as silicate of potash, and mineral or other colours which combine with the silicic acid, so as to form a product which resists the action of oxygen, heat, cold, and moisture. This glazing can be applied to wood, to gas or water pipes, to brick walls, to constructions of stone or cement, etc., and in all cases will prove an effective protection. It has been proposed to use it in boilers, to protect the plates against the too great intensity of the fire. When applied to masonry or to wooden objects, the surface is first to be washed with soap and water. In the preparation of this coating, the refuse of the asbestos, which would be useless for any other purpose, is all that is required.

* * * * *

ELECTRICAL WOOD-CUTTING MACHINE.—Electricity continues to be more and more widely applied in all directions, and we now hear that Th. Günther, of Lerbst, has patented a wood-cutting machine, in which a number of platinum wires are united in a frame, and heated by a galvanic battery, so as to be used as saws for cutting logs into boards. This sounds inviting enough, but surely a platinum saw is a luxury of wood-cutting!

* * * * *

THE LATE MR. JOHN C. TRAUTWINE.—This eminent civil engineer died at Philadelphia on the 14th of last September, aged 73. The Franklin Institute have just published an interesting Memoir of him, which concludes as follows: 'Whether, in future years, his reputation will rest mainly on his explorations or his writings, cannot now be determined. Through each he attained a world-wide celebrity. He was the first man to supply both accurate and comprehensive knowledge of the Isthmus of Darien. All subsequent explorers refer to his work, confirming its results; and it is probable that, a century hence, his name will be as closely identified with schemes of inter-oceanic communication as it is to-day. His published writings, on the other hand, are the text-books of the engineering profession; his name being related to it as that of Gray to botany, or Dana to mineralogy; and, under the editorial care of his son, who was favoured with his special instruction, the present standard of his *Engineers' Pocket Book*, and other works, will doubtless be maintained.'

* * * * *

FIBRE FOR PAPER MANUFACTURE.—Two plants have recently been suggested for supplying a suitable fibre for this purpose. The first is the 'Dwarf Palm' of Algeria, the second the 'Giant Cactus' of Mexico and the Western States. Of these the latter yields double the percentage of fibre, but at present its most flourishing growth is confined to almost unapproachable districts in Southern California, a circumstance which puts it rather out of the question for manufacturing purposes. On the other hand, it is stated that it would flourish well in India, and could it be introduced successfully to some of the sandy wastes of that peninsula, it would prove a valuable export.

* * * * *

CINCHONA CULTIVATION.—Peruvian bark, the produce of the various species of cinchona, has of late years greatly increased in commercial value. Its medicinal value—due to the presence of quinine—has long been known and appreciated, but more recently it has also been used in the manufacture of substitutes for hops and other purposes. Originally, as its commoner name signifies, it was mainly procured from Peru, where, as in other parts of South America, its growth is spontaneous. As, however, the demand increased, and by far exceeded the supply, attempts were made to transplant the trees to other lands. Some years ago it was naturalised in India, and is now flourishing on the Himalayas, as well as in Java, British Burmah, Jamaica, Trinidad, St. Helena, and more recently and especially in Ceylon. The republic of Guatemala has recently arranged with a Ceylon planter for seed for five million cinchona-trees. This is of course a commercial speculation on the part of President Barrios, but should it prove successful there are vast tracts of land in Central America, under similar conditions of soil and climate, which might be most profitably utilised in this manner. It is stated, for example, that the volcanic soil of Mexico is well adapted for the cultivation of both coffee and cinchona.

* * * * *

METALLIZATION OF WOOD.—A French process of rendering wood impervious to damp, etc., is the following treatment: The wood is soaked for two or three days in water at a temperature of from one hundred and sixty-seven to one hundred and ninety-four degrees Fahrenheit; it is then placed in another bath of hydro-sulphate of calcium for twenty-four hours; a concentrated solution of sulphur is added, and after forty-eight hours the wood is finally soaked in acetate of lead at a temperature of from ninety-five to one hundred and twenty-two degrees Fahrenheit for thirty to fifty hours. When dry the wood may be polished until it resembles a metal mirror, and is almost indestructible.

Recent Inspection Questions.

[The Editor respectfully solicits contributions—all of which will be regarded as STRICTLY PRIVATE*—to this column. For obvious reasons, it cannot be stated in which district the questions have been set.]*

Arithmetic.

STANDARD I.—DICTATED.

(1)	(2)	(3)
685	567	6080907
78	293	6
36		
750	274	36485442
407		
1956		

STANDARD II.—DICTATED.

(1)	(2)
13705	8)74053
7856	
5849	9256,—1

(3)	(4)		
37586		s.	d.
357	40 =	3	4
263102	68 =	5	8
187930	96 =	8	0
112758	110 =	9	2
	80 =	6	8
13418202			

N.B.—The Inspector explained on the blackboard how the children were to write the answers to No. 4.

STANDARD III.

(1) Add together £70,401 18s. 7¼d.; £5,560 0s. 9d.; £39 19s. 0½d.; £7,508 17s. 2d.; £69,020 8s. 3¾d.; £4 0s. 7d. (in words).
Ans. £152,535 4s. 5½d.

(2) The father of a family earned 35s. weekly, each of his 3 sons earned 18s. 6d. per week, and his daughter 10s. 6d. What was the total weekly savings of the family, if they spent altogether £4 3s. 6d. per week? Ans. 17s. 6d.

(3) Divide fifty thousand and thirty-one by 79.
Ans. 633—24.

(4) Take £1083 18s. 3¾d. from £20,103 0s. 1¼d.
Ans. £19,019 1s. 9½d.

STANDARD IV.

(1) Divide £65,523 10s. 8¼d. by 117.
Ans. £560 0s. 7¼d.,—1

(2) A farmer bought a flock of sheep for £209 10s., and after he had paid £4 0s. 6d. for feeding, he sold ½ of them for £109 10s. 6d., and the other half for £120 19s. 6d. How much did he gain?
Ans. £16 19s. 6d.

) £209 13s. 0¼d. × 135.
Ans. £28,302 17s. 9¾d.

(4) How many c. yds. in 200,000 c. inches?
Ans. 4 c. yds. 7 ft. 1280 in.

(5) How many hours has a boy lived who is 9 years 57 days old, reckoning 2 leap years?
Ans. 80,256 hours.

STANDARD V.

(1) Bill:—15 yds. of merino at 2s. 5½d. per yd.
72 yds. of calico at 8s. 6d. per doz.
6 doz. buttons at ¼d. a button
5 pairs of blankets at 18s. 9d. per pair
13¾ yds. of silk at 5s. per yard
2 print dresses at 9s. 11½d. each
Ans. £13 11s. 9½d.

(2) If the carriage of 75 lbs. of meat to my house cost 4s. 8¼d., what should be paid for bringing 3 qrs. 14 lbs. at the same rate? Ans. 6s. 1½d.

(3) Find by practice the value of 1709 pairs of blankets if each blanket cost 16s. 7¾d.
Ans. £2844 15s. 5½d.

(4) If a woman can save £6 6s. 2½d. in 13 weeks, how long will she be in saving £5 16s. 6d.?
Ans. 12 weeks.

STANDARD VI.

(1) Find the value of $\frac{7\frac{1}{5}+5\frac{1}{7}}{7\frac{1}{5}-5\frac{1}{7}}$, and divide the result by $\frac{3}{5}$ of $2\frac{1}{2}$. Ans. 4.

(2) How long will it take 12 men to make 360 pairs of boots by working 10 hours a day, if 6 men can make 120 pairs in 20 days by working 8 hours a day?
Ans. 24 days.

(3) How many yards of carpet 33 in. wide will cover a room which requires 24¾ yards of 27 in. in width? Ans. 20¼ yards.

(4) What decimal of a shilling is 8¼d.?
Ans. ·6875.

(5) Find the simple interest on £476 16s. for 3 years 6 months at 6 per cent.
Ans. £100 2s. 6$\frac{8}{25}$d.

STANDARD VII.

(1) In 1871 the population of A was 65,400; that of B was 72,600, and that of C 83,700. In 1881 it was found that A had increased by 25 per cent., B by 56 per cent., and C by 40 per cent. Find the average population of the 3 places in 1871 and 1881.
Ans. 73,900 in 1871
104,062 „ 1881

(2) If a man were able to save 4s. 0½d. weekly after spending $\frac{1}{9}$ of his wages in clothing and repairs, $\frac{5}{12}$ in food, $\frac{3}{16}$ in rent, and $\frac{3}{20}$ for sundries, what would his earnings amount to? Ans. £1 10s.

(3) A man invested £1000 in the 3 per cents. at 90¼, and another invested the same amount in the 5 per cents. at 150½. What would be the annual income obtained by each?
Ans. 1st, £33 4s. 9$\frac{303}{1207}$d.
2nd, £33 4s. 5$\frac{2727}{3017}$d.

(4) A person invested £2000 in the 3½ per cents. at 94$\frac{7}{8}$, and sold out again when they had fallen to 89$\frac{3}{8}$. What did he lose?
Ans. £115 18s. 10$\frac{3}{38}$d.

(5) What would be the true discount on £860 due 18 months hence at 1¾ per cent.?
Ans. £21 19s. 11$\frac{44}{611}$d.

Grammar.

STANDARD IV.

(1) Parse words in italics:—*Thus dwelt together* in *love, these* simple *American farmers, content* and *free from* care.

(2) Make sentences of your own, using one of the adverbs of the above sentence in each.

Make a sentence with 3 adjectives in it qualifying one noun.

Make a sentence containing a relative pronoun.

STANDARD V.

(1) Parse and analyse:—Near the bank of the river, secluded and still, stood the house of the herdsman.

(2) Form nouns from—flow, bleed, wide, certain; and adjectives from—king, hope, mountain, rest, depend, product.

STANDARDS VI. AND VII.

(1) Parse and analyse:—The forests, with their myriad tongues, shouted of liberty, and the blast of the desert cried aloud, with a voice so wild, that he started in his sleep and smiled.

(2) Explain the force of the prefix in:—Export, rebuild, supernatural, subtract, abstain, subterranean.

—o—

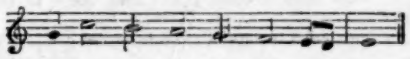
Music.

BY RALPH DUNSTAN, MUS. BAC., CANTAB.;
L. MUS., T.C.L.;
Member of the Council of the Tonic Sol-fa College, etc.

(Continued from page 532.)

TIES OR BINDS, AND SLURS.—A *tie* or *bind* is a sign used in music to indicate that the *two* or more notes connected by it are to be sung or played *as one*, thus:—

In the first bar of this example the first C is sounded and prolonged during the time of *two crotchets*. The two C's thus '*tied*' are therefore equivalent to a *minim*, and are frequently written as such. You will see that the two B's, the two A's, the two G's and the two F's are *tied* in the same manner. Formerly, when musical notation was in its infancy, the passage above would be written thus:—

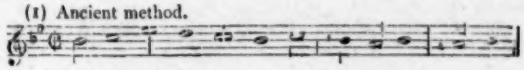


The bar-line is never drawn *through* a note in more modern notation, a *tie* being always used to show the prolongation of a note into the following bar.

The passage above might either be written as in the first example given, or thus:—

Compare also the first of the following with its more modern methods of notation. (The student who has an opportunity of examining ancient church music, either in a museum or a cathedral, or at a bookstall, will be able to find many similar examples, which he should modernise for himself.)

(1) Ancient method.

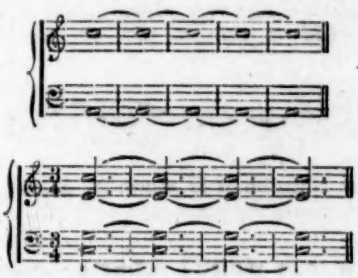


(2) Modern method.

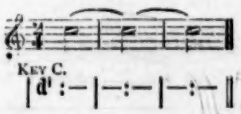
or (3).

No. 3 requires more 'ties' than No. 2, but either of these methods of writing would be allowable: the *performance* being of course the same in any case.

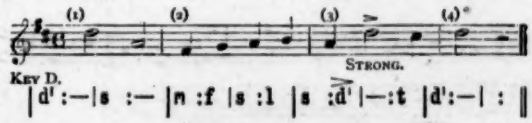
Further uses of the *tie* are here exemplified:—



It will be observed that by means of the tie a note can be prolonged to any length; it answers therefore to the continuation mark in Sol-fa.

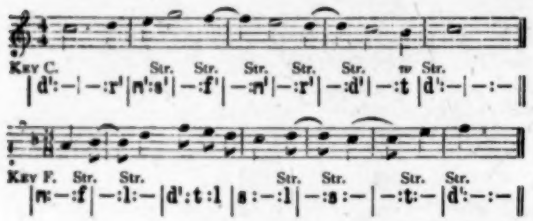


Syncopation.—It will be remembered that musical *accents* follow each other regularly, and observe the same order in every bar or measure throughout the composition. Occasionally, however, the order is broken or disturbed by transferring the emphasis from the STRONG to the *weak* accent, as in bar 3 of the following:—



This temporary displacement or *reversal* of accents is called 'Syncopation.' Syncopation always occurs when a *weakly* accented note is 'tied' to a STRONGLY accented note following it. As the *first* note only is sounded, the accent is transferred to it from the second, and thus a note which ordinarily is of secondary importance is thrust for the time into prominence, and must be strongly emphasised.

The following are examples of syncopation. Notice the use of the *tie* and the reversal of the *accents*:—



Remember these *four* things in connection with the *tie* or *bind*.

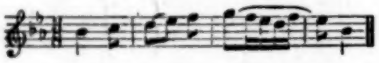
(1) It is used to connect two or more consecutive notes standing on the same line or space.

(2) The first note only is sounded, and it is continued during the whole time indicated by the tied notes.

(3) If the first of the tied notes occur on a *weak* pulse or accent the emphasis or STRONG accent is transferred to it.

(4) The reversal of the ordinary accents is called syncopation.

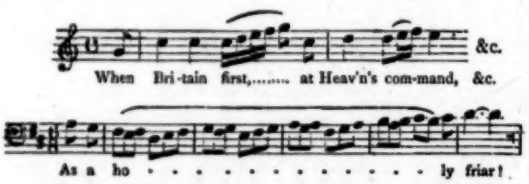
The SLUR is a sign very similar to the tie or bind, but it is used to connect two or more *different* notes :—



In Sol-fa Notation it is shown by a *straight* line drawn underneath the notes.

| d :r :m | s :f.m:r | l :s.f:m.f | r :—:— ||

In vocal music the notes connected by the slur are to be sung to one syllable, as in the following examples :—



In instrumental music the two chief uses of slurs are to indicate what are called 'Phrases,' and to show what notes are to be played in a smooth, flowing, connected, or, as it is termed, '*Legato*' manner. The latter use need only be studied at present :—

The student should try to make the piano or other instrument '*sing*'; and, if he likes, he may regard the notes joined by a slur to go to one syllable, as in vocal music. The violinist plays the two or more slurred notes with *one* stroke of his bow.

DIVIDED PULSES.—We have before shown that a pulse is divided into two equal parts by means of a *dot* or *full-stop*. It may be further subdivided into 'quarter-pulses' by means of *commas* :—

Whole pulses | : | : }

Half-pulses | . : . | . : . }

Quarter-pulses | , . , : , . , | , . , : , . , }

Inverted commas are used for dividing a pulse into 'three' equal parts. A pulse so divided is equivalent to a 'triplet' in Staff Notation.

One-third-pulses | ,, : ,, | ,, : ,, }

The TIME NAMES of the four quarter-pulses are—

1 2 3 4
ta - fa - te - fe (pronounced 'tah-fah-tay-fay');

a silent quarter-pulse being indicated by the letter 'S,' as in the following :—

| d , d . d , d : , d . d , d ||
ta - fa - te - fe Sa - fa - te - fe

| d , , d , d : d , d . d , ||
ta - Sa - te - fe ta - fa - te - Se etc.

The time names for a pulse divided into three equal parts are—

1 2 3
taa - tai - tee (pronounced 'tah-tay-tee').

Thus : | d , d , d : , d , d ||
taa - tai - tee Saa tai - tee

| d , , d : d , d , ||
taa - Sai - tee taa - tai - See

Pulses are also divided into 'sixths,' 'eighths,' and 'ninths.'

Sixths of a pulse may be of two different kinds :—

(1) By dividing each *half-pulse* into *three* equal parts, and placing a figure '3' over each group—

| 3 3 3 3
| ddd . ddd : ddd . ddd ||

Here we have *two* groups of 'three' in each pulse.

(2) By dividing each *third-pulse* into *two* equal parts—

| d d , d d , d d : d d , d d , d d ||

This method gives us *three* groups of 'two' in each pulse.

Eighths of a pulse are shown thus :—

| d d , d d . d d , d d :

and *Ninths* of a pulse thus :—

| 3 3 3
| ddd , ddd , ddd :

TABLE showing PULSES, DIVIDED PULSES, RESTS (or Silences), and TIME NAMES.

(1) WHOLE PULSE; indicated by space from bar-line to colon

| d : from colon to colon : d : from colon to bar-line
TAA TAA

: d | or from colon to sign of *medium* accent : d | d :
TAA TAA TAA

Whole pulse silence; indicated by absence of note, and called SAA

| :
SAA SAA ||

(2) HALF-PULSES; indicated by *dot* or *full-stop*.

| d . d : . d : d . ||
TAA-TAI SAA-TAI TAA-SAI

(3) QUARTER-PULSES; indicated by *comma*.

| d , d . d , d : d , d . , d ||
ta - fa - te - fe ta - fa - Se - fe etc.

(4) THIRDS of a pulse; indicated by '*inverted*' *commas*.

d , d , d :	d , d , d	d , , d : d , d ,
taa - tai - tee	*Saa - tai - tee*	*taa - Sai-tee taa - tai-See*

(5) SIXTHS | $\overset{3}{d}\,d\,d$. $\overset{3}{d}\,d\,d$: $\overset{3}{d}\,d\,d$. $\overset{3}{d}\,d\,d$ |
|---|
| *ta ra la - te re le* *ta ra la - te re le* |

or | d d , d d , d d : d d , d d , d d |
|---|
| *ta fa - te fe - ti fi* *ta fa - te fe - ti fi* |

(6) EIGHTHS | d d , d d . d d , d d : |
|---|
| *tana - fana - tene - rene* |

(7) NINTHS | $\overset{3}{d}\,\overset{3}{d}\,d$, $\overset{3}{d}\,\overset{3}{d}\,d$, $\overset{3}{d}\,\overset{3}{d}\,d$: |
|---|
| *ta ra la - te re le - ti ri li* |

Sixths, eighths, and ninths of a pulse are not often required, and their time names are so unimportant that the elementary student is advised not to learn them. He should, however, be thoroughly familiar with the signs and names for whole pulses, half-pulses, quarter-pulses, and third-pulses.

Some of the most usual combinations of pulses, half-pulses, and quarter-pulses are shown below, and should be carefully studied:—

d : —	
TAA - AA	
d : – . d	
TAA-AA-TAI	
d . d , d :	(half-pulse followed by two quarters)
TAA - te - fe	
d ., d :	(a *three-quarter* tone followed by a one-quarter)
TAA - e/e	
d , d . d :	(two *quarter-pulses* followed by half-pulse)
ta - fa - TAI	

TERMS OF EXPRESSION, PACE, AND STYLE.

A great many signs, words, and abbreviations are used to indicate the manner in which music should be performed. A few of these are given below, and the student must be referred to a dictionary of musical terms for the meanings of more unusual directions.

TERMS OF EXPRESSION, *with abbreviations*.

Forte, for., f, loud.
Fortissimo, ff, very loud.
fff, as loud as possible.
Piano, pia., p, soft.
Pianissimo, pp, very soft.
ppp, as soft as possible.
Mezzo forte, mf, moderately loud.
Mezzo-piano, mp, moderately soft.
Crescendo, cres., or <, increasing in loudness.
Decrescendo, decres., / *Diminuendo, dim.*, > , decreasing or diminishing in loudness.

To these may be added:—

Dolce, dol., soft and sweet.
Forte-piano, fp, suddenly loud, then soft.
Sforzato, or *Sforzando, sf.*, or *fz.*, forced, like *Forte-piano*.
Calando, decreasing.

TERMS OF PACE, OR SPEED.

Largo, very slow.
Larghetto, not quite so slow as *Largo*.
Adagio, slow and expressive.
Andante, at a moderate pace, gently.
Allegro, merry, quick, lively.
Presto, very quick.
Adagissimo, slower than *Adagio*.
Allegretto, not quite so lively as *Allegro*.
Andantino, a modification of *Andante* (a little slower).
Grave, grave, heavy, slow.
Lento, slow.
Moderato, at a moderate speed.
Prestissimo, exceedingly quick; faster than *Presto*.
Tempo comodo, at a convenient and moderate speed.
Tempo ordinario, in ordinary time, moderate.
Accelerando, accel., increasing the pace; *Rallentando, rall.*, slackening the pace.
Ritardando, ritard., rit.; Ritenuto, riten., rit., retarding the pace.
A tempo, in strict time (used after *Accel., Rall., or Rit.*).
Meno allegro, less fast. *Più mosso*, quicker. *Stringendo*, hurrying the pace.

(To be continued.)

—o—

ANSWERS TO ARITHMETICAL QUESTIONS IN 'THE SCHOLAR' FOR JANUARY, 1884.

STANDARD IV.

A. 1. £81,396 14s.
2. £1068 13s. 1½d.,—32.
3. 5,369,760 inches.
B. 1. £258 8s. 5¾d.,—9.
2. 3,217,536 ozs.
3. 11 w. 6 d. 3 h. 36 m. 19s.
C. 1. 4,117,392 c. in.
2. £126,195 6s. 2½d.
3. £188 18s. 11d.
D. 1. £129 16s. 2d.
2. 630 sq. yds. 8 ft. 17 in.
3. 1s. 0½d.,—29,433.
E. 1. 318 bar. 22 gal. 3 pt.
2. £1093 12s. 10⅜d.
3. £112 10s.
F. 1. 118 ml. 653 yd. 1 ft.
2. £42,581 3s. 6d.
3. 1287 times, and 27½ yd. left.

Advanced Examination.

1. £150.
2. 65 suits, and 1 yd. 3 qr. 2 nl. left.
3. £1 8s. 1½d.

STANDARD V.

A. 1. £592 4s. 6⅔d.
2. £143,699 8s. 0⅜d.
3. £9714 16s. 11½d.
B. 1. £9 2s. 10½d.
2. £146 16s. 3⅝d.
3. £221 5s.
C. 1. $2\frac{11}{20}$.
2. $\frac{47}{160}$.
3. $\frac{5}{8}$.
D. 1. £229 10s.
2. 1770 marbles.
3. £36,000.
E. 1. £35 11s. 8⅔d.
2. £150 17s. 3½d.
3. £117 9s. 10½d.
F. 1. 4 ton 5 cwt. 2 qr. 24 lb.
2. 3 to 10.
3. £1732 7s. 7½d.

Advanced Examination.

1. 29½ lb.
2. £531 3s. 2¾d.
3. 15 eggs for 1s.

STANDARD VI.

A. 1. $3\frac{1333}{3333}$.
2. ·9916.
3. £1 4s. 10⅝d.
B. 1. $\frac{88}{333}$.
2. £36 0s. 7$\frac{1}{10}$d.
3. 1776$\frac{6}{19}$ lb.
C. 1. 8670.
2. $\frac{217}{1250}$.
3. £156 17s. 3$\frac{1}{11}$d.
D. 1. £7 7s. 6$\frac{13}{33}$d.
2. $\frac{1}{3}$.
3. £134 10s. 4d.
E. 1. 2½ per cent.
2. 8$\frac{8}{19}$ days.
3. 11$\frac{11}{19}$ hours a day.
F. 1. £2 17s. 6$\frac{3}{11}$d.
2. 1$\frac{1111}{2222}$d.
3. 5147·9289+

Advanced Examination.

1. 6$\frac{133}{333}$ days.
2. $\frac{12}{160}$ day before.
3. 13s. 9$\frac{5555}{7272}$d.

STANDARD VII.

A. 1. £2 1s. 6·3225d.
2. 12s. 6$\frac{8}{10}$d.
3. £869 17s. 7½d.
B. 1. £215 13s. 4$\frac{2}{11}$d.
2. 121$\frac{3}{8}$ days.
3. £77 17s. 2·3203125d.
C. 1. 3$\frac{1}{37}$ per cent. gain.
2. £214 19s. 8$\frac{28}{77}$d.
3. 55 years old.
D. 1. £146 17s. 6d.
2. 16 per cent. loss.
3. 29$\frac{4}{11}$ p. c. gain.
E. 1. 4$\frac{11}{19}$ per cent.
2. 20 per cent.
3. ·21d. in the £.
F. 1. 8$\frac{7}{11}$ per cent.
2. 6¼ per cent.
3. £4400.

Advanced Examination.

1. 25 per cent. loss.
2. £2000.
3. Sept. 7th.

ANSWERS TO ALGEBRA QUESTIONS IN 'THE SCHOLAR,' FOR JANUARY, 1883.

EXERCISE XXVIII.

(1) 24 feet.
(2) 2
(3) 80, 100
(4) 880 men.
(5) 25
(6) 75 gallons.
(7) £400
(8) 28
(9) 84
(10) 240
(11) 8, 9
(12) $16\frac{4}{11}$ mins. past 3.
(13) $10\frac{8}{17}$ minutes past 8
(14) $2\frac{2}{3}$ days.
(15) $13\frac{1}{3}$ days.
(16) 24 hours.
(17) $5\frac{5}{7}$ hours.
(18) £42
(19) Tea 4s. per lb., coffee 1s.
(20) £7, £3 10s.

SOLUTIONS OF THE 'ADVANCED EXAMINATION' QUESTIONS IN 'THE SCHOLAR' FOR JANUARY, 1884.

STANDARD IV.

1. $28 \times 180 \times 160 = 806{,}400$ potatoes $= 134{,}400$ lb. $= 60$ tons, which at £2 10s. a ton $=$ £150. Ans.

2. 3 yd. 1 qr. + 1 qr. 1 nl. + 2 yd. 2 qr. 1 nl. $= 6$ yd. 0 qr. 2 nl. $= 98$ nls.; and 400 yds. $= 6400$ nls., then 6400 nls. $\div$ 98 nls. $=$ 65 suits, and 1 yd. 3 qr. 2 nl. left. Ans.

3. From April 14th to July 2nd (inclusive) is 80 days; and $2\frac{1}{2}$ pints $\times 80 = 200$ pints $= 25$ gallons, which at 1s. 1½d. a gallon $=$ £1 8s. 1½d. Ans.

STANDARD V.

1. 4s. 4½d. $\div 5 = 10\frac{1}{2}$d. a lb. Then $10\frac{1}{2}$d. $\times 6 = 5$s. 3d. price of six lb. of beef or seven lb. of mutton; and 5s. 3d. $\div 7 = 9$d. a lb. for the mutton; hence £1 2s. 1½d. $\div$ 9d. $= 29\frac{1}{2}$ lb. Ans.

2. The four items amount to £89 1s. 3d. + £155 7s. $9\frac{3}{4}$d. + £268 6s. 8d. + £18 7s. 6d. $=$ £531 3s. $2\frac{3}{4}$d. Ans.

3. 24,000 $=$ 240 hundred, which at 5s. 6d. a hundred $=$ £66 cost of the eggs, + £14 $=$ £80 the selling price of 24,000 eggs. £80 $=$ 1600 shillings, and 24,000 $\div$ 1600 $=$ 15 eggs for 1s. Ans.

STANDARD VI.

1. We can take either a coat or a vest as the unit with which to work,—say a vest.

5 (coats) $\times 2\frac{1}{2} = 14\frac{1}{2}$ vests, the equivalent of the 5 coats; then $14\frac{1}{2} + 5 = 19\frac{1}{2}$ vests to be made. Again,—as A can make a coat in 20 hours, he can make a vest in 20 hr. $\div 2\frac{1}{2} = \frac{1}{2}0 \div \frac{5}{2} = 6\frac{2}{3}$ hrs. As B can make a vest in $7\frac{1}{2}$ hours, he can make $\frac{2}{15}$ of one in an hour, and A can make $\frac{1}{6\frac{2}{3}}$ of one in an hour; then $\frac{2}{15} + \frac{3}{20} = \frac{17}{60}$ part done by both in one hour. Now $19\frac{1}{2} = 19\frac{30}{60}$ vests to make, and $(19\frac{30}{60} \div \frac{17}{60} \div 10) = (\frac{1}{2}\frac{1}{0}\frac{9}{0} \times \frac{6}{1}\frac{0}{7} \times \frac{1}{10}) = \frac{3}{17}\frac{9}{0} = 6\frac{17}{17}$ days. Ans.

2. The question simplified reads,—If 300 yards are done by 40 men in 8 days of 10 hours each, in how many days of 9 hours each can 35 men do 500 yards?

$$\frac{8 \text{ days} \times 5 \text{ yd.} \times 8 \text{ m.} \times 10 \text{ hr.}}{3 \times 7 \times 9} = \frac{3200}{189} = 16\frac{176}{189} \text{ days required to}$$

finish the road; but as they had $(25 - 8 =)$ 17 days to do it in, they will finish $17 - 16\frac{176}{189} = \frac{13}{189}$ day before. Ans.

3. 3·17 ton $= 3\frac{17}{100} = \frac{317}{100}$ ton; £4·8½ $= 4\frac{17}{200} =$ £$\frac{817}{200}$; and 9·05 cwt. $= 9\frac{1}{20} = \frac{181}{20}$ cwt. Then £$\frac{817}{200} \div \frac{181}{20}$ $=$ if worked out, the price of a ton in pounds, or a cwt. in shillings; hence $(\frac{817}{200}$s. $\div \frac{181}{20} \times \frac{317}{100}) = \frac{817}{200}$s. $\times \frac{20}{181} \times \frac{317}{100} =$ 13s. $9\frac{3174}{18100}$d. Ans.

STANDARD VII.

1. We will suppose a specific amount to have been spent in goods, say £2400. Then ⅓ would cost £600, which plus 40 per cent. (£240) $=$ £840 selling price of this ⅓; and ⅓ would cost £800, plus 20 per cent. (£160) $=$ £960 selling price of the ⅓; the ⅜ cost £900, plus 5 per cent. (£45) $=$ £945. The 3 sums, £840 + £960 + £945 $=$ £2745 the selling price of $(\frac{1}{3} + \frac{1}{3} + \frac{3}{8} =) \frac{23}{24}$. Again, £2400 + 17½ per cent. (£420) $=$ £2820, the selling price of the whole; hence the remaining $\frac{1}{24}$ must sell for (£2820 − £2745 $=$) £75. As this $\frac{1}{24}$ cost £100 and sells for £75, the result on *it* is 25 per cent. loss. Ans.

2. £1 would in the four years amount to £2·44140625; £4882 16s. 3d. $=$ £4882·8125; and £4882·8125 $\div$ £2·44140625 $=$ £2000. Ans.

3. From the question £80 would make £1 interest in the unknown time at 3½ per cent.; consequently £100 would make ⅘ of £1 $=$ 25s. But £100 would make £3½ in a *year*; and 25s. is $\frac{1}{14}\frac{4}{0} = \frac{1}{5}$ of £3½; hence the bill was paid ⅕ of a year, or 146 days before due, and 146 days after April 14th is Sept. 7th. Ans.

ANSWERS TO ARITHMETICAL QUESTIONS IN THE 'LITTLE LEARNER' FOR JANUARY, 1884.

STANDARD I.

A. (1) 97
(2) 241
(3) 234
B. (1) 2,651
(2) 1,315
(3) 1,274
C. (1) 1,026
(2) 3,512
(3) 1,386
D. (1) 234
(2) 307
(3) 321
E. (1) 466
(2) 333
(3) 34
F. (1) 8
(2) 367
(3) 97
G. (1) 7,069
(2) 14,979
(3) 30,923
H. (1) 951
(2) 3,859
(3) 4,954
I. (1) 18,152,712
(2) 1,073 apples
(3) 94 tops
J. (1) 1,854,423,648
(2) 95
(3) 132 nuts

STANDARD II.

A. (1) 353,299
(2) 44,672
(3) 182,047
B. (1) 36,357
(2) 963
(3) 5,178
C. (1) 426,465
(2) 11,553,360
(3) 24,567,200
D. (1) 4,380,264
(2) 2,834,001
(3) 24,459,870
E. (1) 333,655,760
(2) 69,202,635
(3) 3,482,267,760
F. (1) 6,789
(2) 22,670 + 2
(3) 14,879
G. (1) 9,567
(2) 4,706 + 5
(3) 6,297 + 7
H. (1) 4,312 + 11
(2) 1,275 + 6
(3) 9,698 + 24
I. (1) 49 sixpences; 29s.
(2) 663 miles
(3) 1,293
J. (1) 16 pence
(2) 689,895
(3) 63 nuts

STANDARD III.

A. (1) 1,647
(2) 2,908
(3) 753 + 33
B. (1) 15,429 + 53
(2) 5,370
(3) 7,715 + 19
C. (1) 13,980 + 335
(2) 7,090
(3) 2,916
D. (1) 6,715 + 118
(2) 6,409
(3) 1,630 + 5,923
E. (1) £35 19s.
(2) £188 6s. 10½d.
(3) £1,356 17s. 5½d.
F. (1) £6,804 15s. 11d.
(2) £12,710 9s. 6½d.
(3) £124,931 1s. 2½d.
G. (1) £35 18s. 3d.
(2) £600 7s. 8½d.
(3) £594 14s. 8½d.
H. (1) £3,408 18s. 4½d.
(2) £2,083 14s. 8½d.
(3) £8,608 18s. 6½d.
I. (1) 398
(2) £6 0s. 3½d.
(3) £4 9s. 3d.
J. (1) £68 2s. 1½d.
(2) 7,809 years
(3) 26,810 farthings

Physiology.

BY ARTHUR NEWSHOLME, M.D. LOND.,

Gold Medallist and University Scholar, Physician to the City Dispensary.

CHAPTER VIII.—DIGESTION.

THE digestive apparatus consists of a long tube with several glands appended. The whole canal is about 30 feet long, or 5 to 6 times the length of the body. The parts of it contained in the head and thorax are the mouth, with the teeth, tongue, and salivary glands, the pharynx and œsophagus. The parts contained in the abdomen are the stomach and intestines, with the appended glands, the liver and pancreas.

The *mouth* is the prehensile organ. In connection with it, we have to consider the teeth, tongue, and salivary glands.

There are two sets of teeth in all mammals, the *temporary, deciduous, or milk teeth*, which appear before the age of two years, and the *permanent*, which begin to appear about the sixth year. There are twenty temporary teeth, and thirty-two permanent, or, representing them in a tabular form,—

		Molars.	*Canine.*	*Incisor*	*Canine.*	*Molars.*	
Temporary teeth	upper	2 .	1 .	2.2 .	1 .	2 =	10 =20
	lower	2 .	1 .	2.2 .	1 .	2 =	10
		Molars.	*Bicuspids.*	*Canine.*	*Incisors.*	*Canine.*	*Bicuspids.*	*Molars.*	
Permanent teeth	upper	3 .	2 .	1 .	2.2 .	1 .	2 .	3 =	16 =32
	lower	3 .	2 .	1 .	2.2 .	1 .	2 .	3 =	16

A tooth is, homologically, a calcified process of the mucous membrane; its relation to the mucous membrane is analogous to that of hairs or nails to the skin.

Each tooth consists of three parts, the *crown*, or free projecting part; the *fang*, which is imbedded in the alveolar hollow of the jaw; and the *neck*, the constriction uniting the two other parts, which is situated at the surface of the gum.

A vertical section through a tooth (Fig. 33) shows that the greater part of it consists of *dentine;* the dentine is invested on its free surface by a thin layer of enamel, and on its implanted part by the cement, or *crusta petrosa.* In the middle of the dentine is a large cavity filled with tooth-pulp, which communicates with the periosteum of the bone below.

Dentine in structure is similar to very dense bone, having no lacunæ and Haversian canals. It consists of an apparently structureless matrix, tunnelled with very fine channels, like the canaliculi of bone, but more regular. These dentine tubules are about $\frac{1}{4500}$ inch in diameter; they run outwards from the pulp cavity towards the surface of the tooth, dividing dichotomously as they proceed, and presenting two or three curves in their course. The tubes are filled with a semi-fluid nutrient matter in the living condition. Chemically, dentine is found to contain the same elements as bone, but a larger proportion of earthy matter, that is, 72 per cent. earthy matter, as against the 67 of bone.

Enamel coats over the dentine on the free surface of the tooth, and is much harder than the dentine. It is thickest on the most exposed part, thinning away to the neck of the tooth, where it disappears. It consists of a number of long, narrow, five or six-sided prisms, about $\frac{1}{5000}$ inch in diameter, which are arranged perpendicular to the surface of the dentine. A very thin membrane of a horny character covers over the free surface of the enamel in unworn teeth, called Nasmyth's membrane, or the cuticle of the enamel (Kölliker). Chemically, enamel consists of $3\frac{1}{2}$ per cent. animal matter, and $96\frac{1}{2}$ per cent. earthy matter, the latter including silica and calcic fluoride, as well as the other earthy constituents of bone.

The *Crusta petrosa* enveloping the dentine of the fang is a slightly modified bone, possessing lacunæ and canaliculi larger and more irregular than those of bone, but no Haversian canals.

The cavity of the *Pulp* is filled up with a very vascular material, consisting of connective tissue, with abundant twigs of vessels and nerves. Below, it is organically connected with the periosteum of the bone, from which it receives its blood and nerve supply. (*c* Fig. 33.)

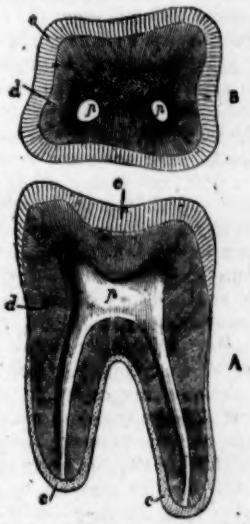


Fig. 33.—A Molar Tooth. *A*. Vertical section. *B*. Horizontal section. *c*. Enamel. *d*. Dentine. *p*. Pulp cavity. *c*. Crusta petrosa.

The development of teeth begins about the seventh week of fœtal life, by the appearance of a shallow groove along the highest part of the gum, the deeper part of the epithelium of the mouth at this part growing downwards, and being met by a vascular papilla, which grows up from the bottom of the groove, and meets the cellular process. The groove gradually becomes filled up and covered in by epithelium, and in the canal thus formed the tooth structures are formed, enamel from the layer of epithelial cells immediately in contact with the tooth-papilla, dentine from the superficial part of the papilla itself, while the remainder of the papilla forms the pulp. As the tooth develops from the summit of the crown downwards, the pulp is gradually enclosed. At a very early period diverticula are formed by a similar ingrowth of epithelium to the above, from the neck of the sacs in which the temporary teeth are developing. These elongate and push their way into the gum behind the germs of the milk teeth, penetrating further away from the alveolar edge of the jaw than the latter. A papilla appears at the bottom of these, and the further development of the permanent teeth is similar to that of the milk teeth. The three permanent molars on each side do not arise as offshoots from the sacs of the milk teeth, but from extensions of the dental groove and

involuted epithelium carried further back in the jaw than the milk teeth.

The temporary teeth appear above the gum in a regular order, the date of which varies within certain limits. The following table represents in *months* the age at which the respective teeth appear.

Molars.	Canine.	Incisors.	Canine.	Molars.
24 12	18	9 7 7 9	18	12 24

The permanent teeth appear above the gums, *i.e.*, are *erupted*, in a definite order. Incisors and canines replace the corresponding milk teeth; prœmolars or bicuspids replace the milk-molars, and three true molars are developed on each side of the two jaws, which have no representatives in the milk set. The teeth of the lower jaw appear in the following order, those of the upper jaw somewhat later. The first molar appears about the 6th year, the central incisors about the 7th year, lateral incisors the 8th year, anterior bicuspids 9th year, posterior bicuspids 10th year, canines 11th to 12th year, second molar 12th to 13th year, third molar (wisdom tooth) 17th to 25th year.

About the 6th year, just before the shedding of the temporary incisors, there are more teeth in and projecting from the jaw than at any other time, namely, all the milk teeth and all the permanent teeth except the four wisdom-teeth, or forty-eight in all.

The *tongue* is composed of a considerable number of muscles, arranged symmetrically on each side of the middle line, and invested on its free surface by a closely-fitting mucous membrane. (1) The attachments of its muscles enable it to move in bulk or in part in a most delicate manner, and enable it to mould itself to examine any cavity in the teeth, etc. (2) It is the most delicate organ of *touch* we possess. Suppose we apply two fine points (as of a pair of compasses) to the surface of various parts of the body, a distance is arrived at which they are only appreciated as if one point. This distance on the back of the hand is $1\frac{1}{2}$ to 2 inches; on the front of finger $\frac{1}{12}$ inch, on the tip of tongue $\frac{1}{24}$ inch.

(3) *Taste* is chiefly effected by the tongue, that is pure taste of bitter and sweet things. (4) The tongue has an important part to play in *mastication* and *deglutition*. (5) It is an important organ of *articulation*. The letters T, D, K, G, S, L, are imperfectly articulated in its absence.

The *Palate* consists of two parts—an anterior hard, and a posterior soft palate. The soft palate hangs down into the pharynx, and is continuous on its upper surface with the posterior cavities of the nose (the posterior nares). On each side the soft palate is continued into the two pillars of the fauces, between which lie the tonsils—glands of obscure function and belonging to the class of ductless glands.

The *salivary glands* are three pairs, which pour into the mouth a liquid secretion called the saliva. Each of these is a compound racemose gland. If we trace their ducts backwards, after branching a number of times they end in minute dilated extremities, called *alveoli* or *acini*, which are lined and almost filled by spheroidal epithelium, while the larger ducts are lined by columnar epithelium, and the smaller by flattened epithelium. Half-moon shaped granular bodies have been found between the cells of the acini and the basement membrane, to which great importance has been attached by some.

The *parotid* is the largest of the three salivary glands. It lies close below and in front of the ear, and can only be felt distinctly when enlarged, as in mumps. Its duct, which is about $2\frac{1}{2}$ inches long, opens into the mouth just opposite the crown of the second upper molar tooth.

The *submaxillary* gland lies under cover of the lower jaw near the middle line. Its duct pierces the mucous membrane of the mouth close to its fellow of the opposite side, on the under surface of the tongue.

The *sublingual* gland is the smallest of the three. It can almost be seen through the mucous membrane in the floor of the mouth, close in front of the tongue. It opens by numerous ducts into the mouth.

The *Saliva* poured out by these glands (and to a less extent from smaller glands in the cavity of the mouth) is a clear viscid liquid, slightly alkaline in reaction, and containing about $\frac{1}{2}$ per cent. of solids, of which the most important is ptyalin. Besides this, there is a minute quantity of sulphocyanide of potassium and certain other salts, with a varying quantity of mucous. (1) The saliva serves to moisten the food, and so aid its deglutition. The drinking of tea or other liquids during mastication is prejudicial to health. (2) It dissolves sapid substances, and renders them competent to act on the sense of taste at once. (3) It has a distinct solvent action on starch, changing it into grape-sugar. Ptyalin is the active agent in the production of the change. It is a hydrolytic ferment, that is, capable of causing the incorporation of water with starch. We may represent its action thus, though it is probable that there are really two steps in the process.

$$\underset{\text{Starch.}}{C_6H_{10}O_5} + \underset{\text{Water.}}{H_2O} = \underset{\text{Grape-sugar or Glucose.}}{C_6H_{12}O_6}$$

Ptyalin is an albuminoid substance, differing from most other albuminoids in not being precipitated at the temperature of 60° C. It may be extracted from saliva by the addition of alcohol, which throws it down, and then redissolving in water. It resembles in its action the diastase of sprouting barley. The various extracts of malt now so commonly sold are intended to aid the assimilation of starchy food in cases of deficient secretion of the natural digestive juices.

The same power of changing starch into glucose is possessed in a slight degree by nearly all animal substances; mucus of the bladder, blood, and muscles have it slightly. The saccharizing power varies in different animals; in the dog (a carnivora) it is very small; in man it is only developed with the teeth. Hence, starchy food ought never to be given until the eighth or ninth month of life, and then only in very small quantities, milk being continued as the chief food. The saliva from different glands is found to vary in composition, and according to Claude Bernard, the secretion of each gland has a different mechanical function; the parotid secretion being concerned in mastication, the submaxillary in taste, and the sublingual (a thick, ropy secretion) in deglutition. This is partly true, but the functions of the different glands are not so exclusively restricted as was at first supposed.

The salivary secretion is derived ultimately from the blood, as all other secretions are, but it is first worked up into the substance of the cells of the gland; and then the secretion is derived by a partial or complete fusion of their substance.

There is (1) a *separation* of certain matter from the blood.
(2) an *elaboration* of these matters by the cells.
and (3) partial fusion of the cells to form the secretion.

Even when the circulation of blood through a salivary gland is stopped, we may, according to Ludwig, by irritating the nerves proceeding to the gland, cause considerable secretion of saliva for a short time. There can be no doubt that the secretion in its origin is largely dependent on nervous influence. According to Pflüger, nervous terminal filaments penetrate the spheroidal epithelium of the glands.

The ultimate source of the salivary secretion is the blood, the spheroidal cells are the agents elaborating it, and the nervous system provides the exciting cause of the secretion.

The exact mechanism of the salivary secretion has been experimentally investigated in the case of the submaxillary gland. This is supplied by three sets of nerves, the *lingual* (which is sensory, or centripetal), the *chorda tympani* (which is motor, or centrifugal), and the *sympathetic*, which controls the size of the blood-vessels, and therefore the amount of blood going to the gland. It is found that secretion can most certainly be produced by the application of food to some part where the lingual nerve is distributed, as the tongue, or experimentally by passing an interrupted current along the lingual nerve. When the chorda tympani nerve is divided such a stimulus is not followed by secretion. We have here an instance of reflex action; the stimulus derived from food, or from the faradic current, is carried to the medulla oblongata, and thence to the salivary gland by the centrifugal nerve.

Secretion of saliva may be caused, again, by direct stimulation of the chorda tympani nerve, at the same time there being a dilatation of the blood-vessels of the gland. The flow of saliva is not, however, a simple consequence of the increased afflux of blood to the gland. This is proved by the fact that we may have secretion in the absence of a blood supply, and that Atropin (the active principle of Belladonna) when taken internally, stops secretion, but does not prevent dilatation of the blood-vessels. It is easy to understand this, just as we know that being fed does not necessarily make a man work better, in the absence of any stimulus. We can only rationally explain these facts by assuming that the chorda tympani nerve has two sets of fibres, —*secreting fibres*, acting directly on the epithelial cells, and *vaso-motor*, or dilating fibres, acting on the blood-vessels. When the cervical sympathetic nerve is stimulated, directly opposite effects, as regards vascular supply, are produced, from those produced by stimulation of the chorda tympani. The blood-vessels become greatly constricted, and a slight secretion of saliva occurs, remarkably viscid, and of high specific gravity. When both the chorda tympani and sympathetic nerves are divided, a copious watery secretion is poured out, called 'paralytic saliva.'

It is evident that saliva is generally secreted in consequence of a reflex stimulation. The aid of *emotion* is also brought into play, and this may cause secretion in the absence of food, as in the 'mouth-watering' produced by the thought of food. Here the origin of the stimulation is a central one, arising higher in the nervous centres than the medulla.

(*To be continued.*)

ANSWERS TO
Pupil Teachers' Examination Papers.

NOVEMBER 24.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. What fraction of a guinea is equal to $\frac{3\frac{3}{10}-2\frac{2}{5}}{4\frac{1}{2}+2\frac{2}{3}}$ of $1\frac{3}{11}$ of £2 7s. 3d.?

(*a*) $\frac{3\frac{3}{10}-2\frac{2}{5}}{4\frac{1}{2}+2\frac{2}{3}}$ of $1\frac{3}{11}$ of £2 7s. 3d. =

$\frac{3\frac{3}{10}-2\frac{2}{5}}{6\ \frac{5+9}{15}}$ of $\frac{14}{11}$ of 567d. $=\{\frac{3}{10}\div 6\frac{14}{15}\}$ of $\frac{14}{11}$ of 567d.

$=\frac{8\times 15\times 13}{30\times 104\times 11}$ of 567d.

$=\frac{1}{33}$ of 567d.

$\frac{1}{33}$ of 567d. to the fraction of a guinea $=\frac{\frac{1}{33}\text{ of }567\text{d.}}{21\text{s.}}$

$=\frac{567}{22\times 21\times 12}$

$=\frac{81\cdot 7}{8\cdot 4\cdot 4}=\frac{9}{88}$. Ans.

2. State and show how the value of a decimal is affected (1) by placing a cypher after it, and (2) by placing a cypher before it.

Write in the form of a vulgar fraction the value of each significant figure in ·0903$\dot{7}$.

By placing a cypher after a decimal the value is not affected, for ·3 = ·30 since ·3 = either $\frac{3}{10}$ or $\frac{30}{100}$, but if the cypher be placed before the decimal the value is only one-tenth of what it originally was; ·3 = $\frac{3}{10}$, but ·03 = $\frac{3}{100}$.

In ·0903$\dot{7}$, the 9 = $\frac{9}{100}$; the 3 = $\frac{3}{10000}$, and the 7 = $\frac{7}{9000000}$. Ans.

3. Express the sum of 3·0625 weeks and 5·08$\frac{1}{3}$ of a day as the decimal of a year (= 365$\frac{1}{4}$ days) to 4 decimal places.

3·0625 weeks + 5·08$\frac{1}{3}$ = 21·4375 days + 5·08$\frac{1}{3}$
= 26·5208$\frac{1}{3}$ days.

days. days.
365·25)26·52083(·0726...Ans.
25·5675
95333
73050
222833
219150
.....

4. A man loses $\frac{1}{10}$ of his money and gains £12; he then loses $\frac{1}{3}$ of what he has and gains £10; he finally loses $\frac{1}{8}$ of what he has, and finds that he has £30 left. What had he at first?

(*a*) £30 = $\frac{7}{8}$ of his money before his final speculation,
∴ $\frac{1}{8}$ of £30 = " " " " " " = £36.
(*b*) £(36 − 10) = $\frac{2}{3}$ of his money " 2nd "
∴ £26 × $\frac{3}{2}$ = his money before " " " = £39.
(*c*) £(39 − 12) = $\frac{9}{10}$ of his money before his 1st "
∴ £27 × $\frac{10}{9}$ = his money " " " " = £30.

FEMALES.

1. How much greater is the sum of $3\frac{1}{2}$ and $2\frac{2}{3}$ than their difference?

$3\frac{1}{2}+2\frac{2}{3}=3\frac{3}{6}+2\frac{4}{6}=6\frac{1}{6}$ sum
$3\frac{1}{2}-2\frac{2}{3}=3\frac{3}{6}-2\frac{4}{6}=\frac{5}{6}$ diff.
Sum is greater than diff. by $5\frac{1}{3}$. Ans.

2. The population of a parish exceeds 3000 and is less than 4000; whether the people are arranged in groups of 8, of 9, of 15, of 18, or of 25, 7 always remain over. Find the exact population.

The L.C.M. of 8, 9, 15, 18, 25 =
5 × 5 × 9 × 4 × 2 = 1800
The next common multiple = 3600 which is greater than 3000 and less than 4000; therefore, in order that 7 may always remain over the population must be 3607. Ans.

3. Find, by practice, the cost of 7777 yards of velvet at 17s. 8¼d. per yard.

		£	s.	d.			
10s. = ½ of £1	7777	0	0	= value at £1 per yard.			
	3888	10	0	=	,, ,,	10s. ,, ,,	
5s. = ¼ of 10s.	1944	5	0	=	,, ,,	5s. ,, ,,	
2s. 6d. = ½ of 5s.	972	2	6	=	,, ,,	2s. 6d. per yd.	
2½d. = 1/10 of 2s. 6d.	81	0	2½	=	,, ,,	2½d. ,, ,,	
¼d. = 1/10 of 2½d.	8	2	0½	=	,, ,,	¼d. ,, ,,	
	6893	19	8¾	= 7777 yds. at 17s. 8¼d. yd.			

4. Make out as a bill:—

13½ cwt. of sugar at £2 3s. 6½d. per cwt.
9½ yds. of calico at 4¼d. per yard.
17¾ lb. of beef at 7½d. per lb.
27 lb. of butter at 1s. 3½d. per lb.
A stone of salt at ¼d. per lb.

	£	s.	d.		£	s.	d.
13½ cwt. at	2	3	6½	per cwt. =	29	7	9½
9½ yds. at	0	0	4¼	per yd. =	0	3	9½
17¾ lb. at	0	0	7½	per lb. =	0	11	1¼
27 lb. at	0	1	3½	per lb. =	1	14	3½
1 stn. at	0	0	0¾	per lb. =	0	0	3¾
					31	17	3¼ Ans.

Grammar.

MALES AND FEMALES.

1. I walked *about*, *admired* of *all* and *dreaded*
On hostile ground, *none daring* my *affront*,
Then *swoll'n* with pride into the snare I *fell*.
SAMSON AGONISTES.

Analyse the above, parsing the words in italics.

2. What is the ordinary ending of past participles of (*a*) strong verbs, (*b*) weak or regular verbs.

Illustrate your answer from the above passage.

ANALYSIS.

Sentences.	Kind.	Subject.	Predicate.	Extensions.	Connective.
1. I walked about, admired of all and dreaded on hostile ground, none daring my affront.	Principal	I..., admired of all... ground	walked	about (*place*) none daring my affront (*accompanying circumstances*)	
2. Then swoll'n with pride into the snare I fell.	Principal	I swoll'n with pride	fell	into the snare (*place*)	(and)

PARSING.

about—adv. of place mod. 'walked.'
admired—complete part., qual. 'I.'
all—indef. adj pron., mas. or fem., obj. gov. by 'of.'
dreaded—complete part., predic. of 'I.'
none—indef. adj. pron., mas. or fem. sing., nom. absolute with 'daring.'
daring—incomplete part. of *dare*, *durst*, *dared*, forming with 'none' the nom. absolute.
affront—abstr. noun, neut. sing., obj. gov. by 'daring.'
swoll'n—complete part. of *swell*, *swelled*, *swollen*, predic. of 'I.'
fell—intrans. irreg. verb, *fall*, *fell*, *fallen*, indic. past indef., 1st pers. sing., agr. with 'I.'

The ordinary ending of (*a*) strong verbs is *-en* (*-n*), as *swollen*, *fallen*, and of (*b*) weak or regular verbs, -ed (-d), as *admired*, *dreaded*.

3. The affix 'ing' may indicate (1) a present participle; (2) a verbal noun; (3) an adjective. Write out three sentences, introducing the word 'daring' in each of these uses.

(1) The soldier daring all dangers led the way.
(2) We prevented the man from daring such a danger.
(3) The daring soldier led the forlorn hope.

Geography.

(*Answer Question* 1 *and one or both of the others.*)

1. Draw a full map of South Scotland, from the Firths of Clyde and Forth to the Solway Firth and the mouth of the Tweed; and describe, as fully as you can, referring to your map, the water-partings and river-basins of that section of the country.

N.B.—Insert the lines of latitude and longitude.

The Lammermoor and Pentland Range forms the southern boundary of the Forth basin, and consists of the following parts:—the Lammermoors between Haddington and Berwick; the Moorfoot Hills, a continuation of the Lammermoors; the Pentland Hills in Mid-Lothian, and Tinto Hill in Lanark.

The Cheviot and Lowther Range extends from Peel Fell in the Cheviots proper to Loch Ryan, and forms the great water-parting of the South of Scotland, separating the basins of the Clyde and Tweed on the north from those of the Solway (and the Tyne) in the south.

The basins of the Tweed and the Solway constitute the Southern Highlands, and form an excellent pastoral country.

2. Say what you know about Warwickshire, Wiltshire, and County Galway.

Warwickshire is a Midland county of England in the basins of the Severn and Trent. Its surface is elevated, and diversified by gentle hills and vales; has a mild and salubrious climate, and the soil is generally well cultivated and very fertile. The most valuable minerals are coal and limestone. It has important manufactures, especially hardware, arms, watches, jewellery, silk, and ribbons. The chief towns are Warwick, Rugby, Coventry, Birmingham, the last a most famous manufacturing town.

Wiltshire is a southern inland county of England. Its centre is occupied by the table-land of Salisbury Plain, on which are the celebrated Druidical remains of Stonehenge. The rivers Avon and Kennet and some affluents of the Thames take their rise in Salisbury Plain. In the north and south much of the soil is fertile, but more attention is given to dairy farming than to tillage. On the Downs in the south thousands of sheep are pastured, and in many places pigs are reared in large numbers. The county is celebrated for its bacon, and also for its cheese. The manufactures of Wilts are varied and important, these being broad cloths, carpets, and gloves. The chief towns are Wilton, Salisbury, Malmesbury, Trowbridge, Swindon, and Chippenham.

Galway, the second largest county in Ireland, lies on Galway Bay, between the counties of Mayo and Clare. Lough Corrib divides the county into two districts, the East and the West. The East district is level and generally arable, but it contains much bog. The West, called Connemara and Joyce's Country, is rugged and mountainous, and contains some of the grandest scenery in Ireland. The principal rivers are the Shannon, Suck, and Blackwater. Lough Mask is partly in this county and partly in Mayo. Off the coast, which is rugged and deeply indented, lie a great many islands. Marble and limestone are the chief minerals now worked—the marble of Connemara being of that beautiful green variety called serpentine. The people are mainly employed in agriculture.

3. Which is the more flourishing of these two Australian colonies, Victoria or West Australia? What advantages has it over the other?

Victoria is the more flourishing of the two. Its plains are of such extent, and so sparingly wooded, that it has been said that the plough could in some parts be drawn continuously for one hundred miles across tracts well-suited for agriculture. The climate is more genial to the British race than that of any other colony in Australia. Western Australia on the other hand may be described as a vast forest of bushes, scrubby trees and heavy timber. Little is known of the interior, but water seems to be comparatively scarce, the streams being few and feeble. The fact that this colony continued to receive convicts longer than the other colonies has retarded its prosperity.

History.

1. Between Julius Cæsar and William of Normandy, what nations invaded this country?

After Julius Cæsar's invasion in 54 B.C., the Romans returned to take possession in 43 A.D., and continued to hold Britain till about the year 410. In 449 a band of Jutes under Hengist and Horsa came to England to assist in driving back the Picts and Scots. Large numbers of Angles and Saxons came over at

various times between 449 and 586, and established the various Anglo-Saxon kingdoms.

In 789 the Danes began their ravages, and continued their incursions at various dates, till, in 1013 under the leadership of Sweyn they conquered England, and held possession of the country till the Saxon line was restored in 1041 in the person of Edward the Confessor.

The Norman invasion, under William the Conqueror, took place in 1066.

2. Sketch the history of Alfred the Great.

Alfred the Great, fourth son of Ethelwulf, was born at Wantage, in Berkshire. After the death of his three brothers he came to the throne, in 871, and during a reign of thirty years he was constantly at war with the Danes. They were successful in making head against him. In 877 he was forced to disband his troops, and he retired to Athelney. During his wanderings the tales of his entering the Danish camp as a harper, and his adventure with the neatherd's wife, who scolded him for letting the cakes burn, etc., are well known. Having learnt the plans of his enemies, he defeated them at Ethandune, 878, recovered possession of London, and devoted himself to the improvement of his kingdom. In 896 he repelled a new Danish invasion, and died in 901.

Alfred was the first English monarch who possessed a fleet. He is most celebrated, however, for his laws, which were chiefly digested from the former codes and customs of the Anglo-Saxons. He endeavoured to promote learning in his kingdom, and some of his writings and translations remain to this day. The name of Alfred will always stand in the foremost rank of kings who have, in spite of difficulties and disadvantages, illustrated their own age and deserved well of those that followed them.

3. What do you know about Stonehenge, Tintagel, Corfe Castle, and St. Martin's Church in Canterbury?

Stonehenge is an assemblage of upright and horizontal stones on Salisbury plain in Wilts, generally supposed to be the remains of an ancient Druidical temple.

Tintagel is supposed to be an ancient British Castle, intended for residence as well as defence. It is situated on the north coast of Cornwall, near Bossiney.

Corfe Castle is in Dorset, near the centre of the Isle of Purbeck. At the gates of its old castle King Edward the Martyr was assassinated by his stepmother Elfrida. Corfe Castle was an important stronghold during the Civil War of Charles I.

St. Martin's Church in Canterbury was a little Roman Church given to Augustine and his monks to worship in. This church, or one near it, became the Cathedral Church of the first Archbishop of Canterbury.

Composition.

Write from memory the substance of this passage read to you by the Inspector:

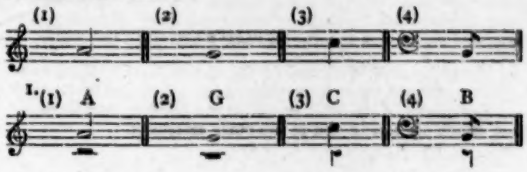
On board a steamer with a cargo of grain from New York for Leghorn the rats multiplied exceedingly. On the return voyage the cargo consisted of oranges and lemons, which the rats did not like; being very numerous, and very hungry they gave great trouble. It was not unusual for from thirty to fifty to be caught and drowned in a single day, but this made no perceptible difference in their numbers. After some time they invaded the saloon and state-rooms, and if one entered the saloon after dark, one heard a sound of hundreds of rats scampering off. The state-rooms became unbearable, and sleep was a luxury to be enjoyed by day only. Soap, shoes, trunks, clothes, were eaten and destroyed by the ravenous herd, rendered wild by famine and bold by countless numbers. Several of the sailors were severely bitten in their sleep, and a good-sized dog, which at first had killed many rats, became in the end afraid to go below and lived upon deck. When the steamer reached New York, for days the rats were seen leaving the ship at all hours.

Music.

A quarter of an hour allowed for this paper.

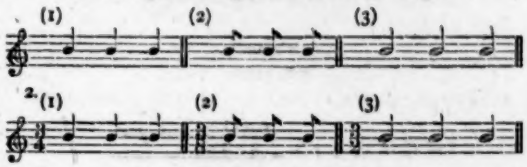
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write above each of the following notes its pitch-name (C, D, &c.); and below write the signs for rests corresponding in value to the notes:—



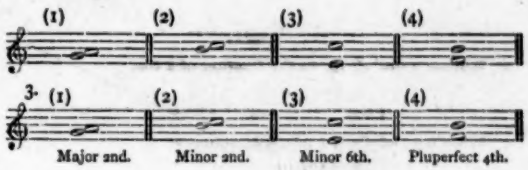
1. (1) A (2) G (3) C (4) B

2. Add the proper time-signatures to the following:—



2. (1) (2) (3)

3. Write below each of the following intervals its name (major fourth, &c.):—



3. (1) (2) (3) (4)

Major 2nd. Minor 2nd. Minor 6th. Pluperfect 4th.

TONIC SOL-FA NOTATION.

1. Re-write the following, doubling the value of every note:—

|m :— |f :r |l :s |s :— ‖

1. |m :—|— :—|f :— |r :—|l :— |s :—|s :—|—:— ‖

2. What do "Key A," "Key B," mean at the beginning of a tune?

2. "Key A" (or "Key B") means that after sounding the note C[1] on a tuning-fork, we are to run down to A (or B), and take it for the *doh* of the tune intended to be sung.

3. Write the names of the following intervals:—(1) *soh* to *lah*; (2) *te* to *doh*[1]; (3) *me* to *doh*[1]; (4) *fah* to *te*.

3. (1) Major 2nd; (2) Minor 2nd; (3) Minor 6th; (4) Pluperfect 4th.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed for this Paper.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

1. Define *obtuse angle*, *polygon*, *scalene triangle*, *oblong*, *trapezium*, and explain the difference between *postulate* and *axiom*.

An *obtuse angle* is that which is greater than a right angle.

A *polygon* is a figure contained by more than four straight lines.

A *scalene triangle* is that which has three unequal sides.

An *oblong* is a four-sided figure which has all its angles right angles, but has not all its sides equal.

A *trapezium* is a four-sided figure, which is not a parallelogram.

A *postulate* may be defined to be a simple problem which is admitted to be self-evident; and an *axiom* may be defined as a simple theorem the truth of which is admitted without proof. Postulates are used in the *constructions*; axioms in the *proofs*.

2. Upon the same base, and on the same side of it, there cannot be two triangles that have their sides which are terminated in one extremity of the base, equal to one another, and likewise those which are terminated in the other extremity.

Prop. 7, Bk. I.

3. If one side of a triangle be produced, the exterior angle is greater than either of the interior opposite angles.

Prop. 16, Bk. I.

Arithmetic.

FEMALES.

1. What part of $\frac{4}{11}$ of 2 acres is $\frac{5}{6}$ of $1\frac{1}{2}$ of $3\frac{3}{4}$ square yards?

$$\frac{\frac{5}{6} \text{ of } 1\frac{1}{2} \text{ of } 3\frac{3}{4} \text{ sq. yds.}}{\frac{4}{11} \text{ of } 2 \text{ ac.}} = \frac{\frac{4\times11\times15}{5\times6\times4} \text{ sq. yds.}}{\frac{4\times2\times4840}{11} \text{ sq. yds.}} = \frac{4\times11\times15\times11}{5\times6\times4\times4\times2\times4840} = \frac{11}{1152}. \text{ Ans.}$$

2. Reduce 2 qrs. 27 lb. to the fraction of a ton.

$$\frac{2 \text{ qrs. } 27 \text{ lbs.}}{1 \text{ ton}} = \frac{83 \text{ lbs.}}{20 \text{ cwt.}} = \frac{83}{2240}. \text{ Ans.}$$

3. What part of £2 is $\frac{3}{5}$ of a half-guinea?

$$\frac{\frac{3}{5} \text{ of } 10\frac{1}{2}\text{s.}}{£2} = \frac{42}{5} \div 40 = \frac{42}{200} = \frac{21}{100}. \text{ Ans.}$$

4. Reduce to a decimal $3\frac{3}{4}$ of $2\frac{1}{2}$.

$$3\frac{3}{4} \text{ of } 2\frac{1}{2} = 3{\cdot}75 \times 2{\cdot}5 = 9{\cdot}375. \text{ Ans.}$$

Grammar.

MALES AND FEMALES.

1. As with the force of winds and waters *pent*
When mountains tremble, *those two* massy *pillars*
With horrible convulsion *to and fro*
He *tugg'd*, he shook, *till down* they came and *drew*
The whole roof after *them*.—MILTON.

Analyse the above, parsing the words in italics.

ANALYSIS.

Sentence.	Kind.	Subject.	Predicate.	Object.	Extensions.	Connective.
(1) As with the force of winds and waters pent he tugged those two.... to and fro.	Principal	he	tugg'd	those two massy pillars	as with the force of winds and waters pent (*manner*) with horrible convulsions (*manner*) to and fro (*manner*) sents. 4 and 5 (*time*)	(and)
(2) As with, etc., he shook those two, etc..... to and fro.	Principal	he	shook	*do.*	*do.*	
(3) When mountains tremble.	Subord. adv. to 1 and 2.	mountains	tremble		when (*time*)	when
(4) Till down they came.	Subord. adv. to 1 and 2.	they	came		down (*place*)	till
(5) And (till) (they) drew the whole roof after them.	Subord. adv. to 1 and 2.	(they)	drew	the whole roof	after them (*manner*)	and (till)

PARSING.

pent—part. adj. predic. of 'waters.'
those—demonst. adj., plur., dist. and agr. with 'pillars.'
two—numeral adj., numbering 'pillars.'
pillars—com. noun, neut., plur., obj. gov. by 'tugged' and 'shook.'
to and fro—adv. phrase of manner, mod. 'tugged' and 'shook.'
tugged—reg. trans. verb, indic. past indef., 3rd pers., sing., agr. with 'he.'
till—subord. temporal conj., gov. subord. sent. 'down they came.'
down—adv. of place, mod. 'came.'
drew—irreg. trans. verb, *draw, drew, drawn*, indic. past indef., 3rd pers., plur., agr. with 'they.'
them—demonst. pers. pron., 3rd pers., plur., neut. obj., gov. by 'after.'

2. From what language are the noun-ending 'ance' and the adjective-ending 'ive' derived? Give instances of each, and state what meaning these terminations give to words.

The ending 'ance' is derived from the Latin language, and means 'being' or 'state of being;' as, abundance, redundance, attendance, ignorance, significance.

The ending 'ive' is also from the Latin, and means 'inclined to' or 'apt to;' as, captive, restive, positive, active, progressive.

3. Paraphrase the following:—

'I dare do all that may become a man;
Who dares do more is none.'

I am not afraid to use manly and honourable means: no one is a man in the true sense who is rash enough to go further than that.

Geography.

Answer Q. 1, and one or both of the others.

1. Explain, as you would to children, the exact difference between the *bed*, the *course*, and the *basin* of a river. Do this by description, not by definition; and illustrate your answer by reference to the Severn, the Danube, and the Ganges. Draw sketch-maps of these basins.

BED.—The *bed* of a river is the channel or trench in which the river runs, and which has been scooped out by the Severn, Danube, Ganges, or other river in the course of ages. These rivers follow the lowest levels of the districts through which they flow, and the sides which bound their beds are called banks. These beds are stony or rocky among the mountains, and gravelly or sandy, according to the nature of the country.

COURSE.—The *Severn* has a course N.E. through Montgomery, E. and S.E. through Shropshire, S. through Worcester and Gloucester. The *Danube* has its course E. through Hohenzollern, Wirtemberg, Bavaria, Austria; E. and S. through Hungary, and enters Servia at Belgrade; E. separating Servia from Hungary and Bulgaria from Wallachia. The *Ganges* has the first part of its course through the Himalaya chain, enters the plain of India at Hurdwar. Below Hurdwar its course is first S.E. to Allahabad; next, E. to the Rajmahal Hills; and lastly, S. to the sea.

BASIN.—The *Severn* is partly an English and partly a Welsh river. The Welsh part of its basin slopes to the E. and is bounded on the N. by the Berwyn Range. On the S. it is bounded by highlands stretching E. from Plynlimmon, portions of which highlands are known as the Wenlock Edge Hills, the Clee Hills, Radnor Forest, and the Malvern Hills. The English portion of the basin slopes gently to the S. and W. It is bounded by the watershed stretching from Bardon Hill to Cheshire, and on the E. by the watershed extending from Bardon Hill to the Cotswolds. The *Danube* basin is bounded by the Alps, the Balkans, the Riesen-gebirge mountains, the Bohemian forest, and Schwartz Wald. The whole basin is divided into four smaller ones; the first being from its source to Passau; the second from Passau to the bend of the river above Vienna; the third includes the greater part of Hungary and Transylvania; and the fourth comprises Wallachia, etc. The eastern part of the basin of the *Ganges* lies in the great plain of Hindostan, the lowest, most fertile, and most populous region of India. South of this plain the country gradually rises into a low table-land, backed by the chain of the Vindhya mountains.

2. Explain the meaning of the word '*tropics*'; and say which of the British possessions have strictly a tropical climate. Why is it hotter in those parts of the world?

At a point 23½° north of the equator (at the tropic of Cancer), the vertical sun appears to stop when it is mid-summer with us. As it moves southward our days grow shorter; it crosses the equator and appears to travel on until it has reached 23½° on the other side of the line (the tropic of Capricorn); then six months have passed—it is mid-winter with us and mid-summer with the people in the southern hemisphere. The sun turns back (the word *tropic* meaning the place of turning), retraces its course over the equator, and at the expiration of another six months is at our tropic (Cancer) again, bringing us summer.

The British possessions that have a tropical climate are the greater part of India, northern part of Australia, Ceylon, Labuan, Hong-Kong, and Kowloon; Aden and Perim; Straits Settlements; Mauritius, Seychelles, Amirante and Chagos Is.; Gambia, Sierra Leone, Gold Coast, St. Helena, and Ascension; Guiana and British West Indian Islands.

The reason that it is hotter in those parts of the world arises from the fact of their being within the Torrid Zone, where the sun is vertical at noon over every place two days in the year. The more nearly the sun approaches the zenith of an observer the more powerful is the heat.

3. Say what you know about Amsterdam, Munich, Astrakhan, Lahore, Hyderabad and Kandy.

Amsterdam is a great commercial city and capital of N. Holland, situated at the confluence of the Amstel with the Yan arm of the Zuyder Zee. It is built in a marsh on piles, and can accommodate in its harbour 1000 vessels. The city is intersected by canals, which are spanned by bridges and ornamented with fine trees.

Munich (München), capital of Bavaria, in Germany, stands on the Isar. It contains fine buildings, libraries, a fine collection of painting and sculpture, and manufactures philosophical instruments. Next to Madrid, it is the most elevated city in Europe.

Astrakhan, a city of Russia, stands in an island in the Volga about fifty miles from the mouth of the river. From its favourable situation it has become the entrepôt between Russia, Persia, and India.

Lahore, the capital of the Punjaub (India), is a large and splendid city, containing numerous mosques and Hindoo temples. It has many remains of ancient greatness, and came into the possession of the British in 1849.

Hydrabad, capital of Scinde, near the Indus. Near it is Meeanee, the scene of Sir C. Napier's victory in 1843. Another city of the same name is the capital of the Nizam's dominions, a large and beautiful city, near which is Golconda, formerly noted for diamonds.

Kandy is a town in the interior of Ceylon, and surrounded by wooded hills. It was formerly the capital of a native kingdom.

Arithmetic.

MALES.

Two hours and a half allowed.

1. Find the simple interest on £875 from March 10, 1882, to August 3, 1883, at 4½ per cent. per annum.

From March 10 to Aug. 3 are 146 days.
∴ The time the money is at interest = 1⅔ yr.

$$\text{Hence interest} = £875 \times 1\tfrac{2}{3} \times \frac{4\tfrac{1}{2}}{100}$$
$$= \frac{£875 \times 7 \times 9}{5 \times 200}$$
$$= £55{\cdot}125$$
$$= £55\ 2s.\ 6d. \quad \text{Ans.}$$

2. A man's premium of insurance at £2 2s. 8d. per cent. amounts to £53 6s. 8d. What is the sum insured for?

£	s.	d.		£	s.	d.		£
2	2	8	:	53	6	8	::	100 : ?
20				20				
42				1066				
12				12				
512				12800				

$$\frac{£100 \times 12800}{512} = £2500. \quad \text{Ans.}$$

3. A dealer bought 30 sheep at an average price of £2 10s. each; eight of the sheep cost £2 8s. each, and 16 of them £2 12s. 6d. What did each of the rest cost?

	£	s.	d.	£	s.	
30 sheep at £2½				= 75	0	
8 sheep at	2	8	0	= 19	4	} = 61 4
16 ,,	2	12	6	= 42	0	
∴ the remaining 6 sheep cost					13	16
and 1 ,, ,,					2	6 Ans.

4. How much money must a man invest in 4½ per cent. railway stock at 137⅞ to get an income of £63, the usual brokerage being charged?

£137⅞ + ¼ or £137½ brings £4½.
£ £ £
∴ 4½ : 63 :: 137½ : ?

$$\frac{£275 \times 126}{2 \times 9} = £1925. \quad \text{Ans.}$$

History.

MALES AND FEMALES.

1. Where is the New Forest? Narrate any historical events connected with it.

William the Conqueror's love of the chase led to the formation of a great hunting-ground lying between Winchester and the sea, and called the New Forest.

In this forest three of the Conqueror's descendants met their death either by design or accident; namely, Richard, his second son, slain in his youth; another Richard, son of Duke Robert; and William II. (Rufus) while hunting (1100).

2. How was Wales united to England?

In 1276 Edward I., in pursuit of his determination to reduce the whole island under one dominion, had turned his arms against Wales. Llewellyn, Prince of Wales, refused to come before the English king and do homage. He was declared to be a rebel, and Edward invaded his country in 1277. The English troops, in irresistible force, hemmed in Llewellyn and his Welshmen in the mountainous district of Snowdon, and forced them by famine to submit. Llewellyn did homage at Westminster, and agreed to pay an annual tribute. Peace was for a time kept, but in 1281 the Welsh patriots rose in arms, and Edward again invaded their country in great force. In 1282 the struggle virtually ended with the defeat and death of the Welsh prince, whose head was set up at the Tower of London. His brother David, who maintained a desultory struggle for independence, was betrayed to Edward, and his head was set up beside his brother's. In 1283 Wales was thus brought under English rule.

Wales was not, however, really united to England till the reign of Henry VIII. (1536), when the remains of feudal power held by the barons were abolished, English laws were established, and Welsh members were elected to the House of Commons.

3. Who were the Tudors, and how did they rise to supreme power?

The Tudors were a dynasty of English sovereigns, and the House comprised Henry VII. (1485-1509), Henry VIII. (1509-1547), Edward VI. (1547-1553), Mary I. (1553-1558), and Elizabeth (1558-1603).

Henry VII., the first of the Tudor dynasty, acquired the royal power by conquest, without real title. Edward IV.'s heir was his eldest daughter, the Princess Elizabeth of York. After her by right came the young Edward, Earl of Warwick, representative of the Duke of Clarence. He was at the time a boy of fifteen, and was committed by the usurper to the Tower. Henry was the head of the Lancastrian line; his mother, Margaret Beaufort, being great-grand-daughter of John of Gaunt, son of Edward III. His father, Edmund Tudor, was the son of Owen Tudor and Queen Catherine, widow of Henry V. An Act of Parliament confirmed the possession of the throne to Henry and his heirs.

Teaching.

How would you explain the meaning of 'carrying' from one column to another in an addition sum?

The best way to explain 'carrying' is to set an example on the blackboard, work it in presence of the class, and explain the process as the work proceeds.

Let the first or right-hand column be regarded as containing units of the first rank, each being valued at *one;* the second column as containing units of the second rank, each valued at *ten;* and so on. Then remembering that tens of the first rank are units of second, tens of the second units of the third, etc., we may add each column as one of unit-, dividing its sum into tens and units, and carrying the tens to the next line.

For example by adding together 69, 43, and 27, we obtain,

69
43
27

139

Explanation :—When we take the sum of 7 units, 3 units, and 9 units, we get 10 units and 9 units, or 19 units, that is, 9 units of the first rank, and 1 of the second; we therefore place the 9 under units of the same rank and *carry on* the 1 ten to the next column, namely, the column of tens (or units of the second rank).

Now the sum of 1 ten, 2 tens, 4 tens, and 6 tens, is 10 tens and 3 tens, or 13 tens.

Music.

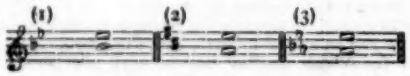
A quarter of an hour allowed for this paper.

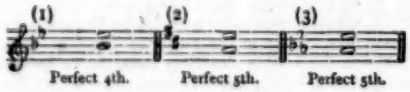
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write the key-signatures of each of the following major keys :—(1) of A♭; (2) of E; (3) of F.

1.

2. Write below each of the following intervals its name (major third, &c.) :—



2. 

Perfect 4th. Perfect 5th. Perfect 5th.

3. Write the proper time-signatures to the following :—

3.

TONIC SOL-FA NOTATION.

1. What is the mental effect of *te*? and of *fah*? and of *lah*?

1. The mental effect of *te* is *piercing* or *sensitive*; of *fah* is *awe-inspiring*; of *lah*, *weeping* or *mournful*.

2. Write the names of the following intervals :—(1) *doh* to *fah*; (2) *me* to *te*; (3) *fah* to *doh'*.

2. (1) Perfect 4th; (2) Perfect 5th; (3) Perfect 5th.

3. Write (1) a six-pulse measure; (2) a four-pulse measure; (3) a two-pulse measure.

3. Primary forms.

(1) | : : | : : ‖
(2) | : | : ‖
(3) | : ‖

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on or after 1st May,* 1878; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

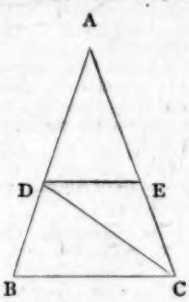
Euclid.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including Question 1, *if you can.*

MALES.

1. ABC is an isosceles triangle: find points D, E in the equa sides AB, AC such that BD, DE, EC may all be equal.



Bisect ∠ACB by DC meeting AB in D. Draw DE ∥ BC.

∵ DE is ∥ BC, ∠EDC = ∠DCB, but ∠DCB = ∠DCE.
∴ ∠EDC = ∠ECD, and ∴ DE = EC (I. 6).

Again ∵ DE is ∥ BC, ∠ADE = ∠ABC, and ∠AED = ∠ACB.

∴ ∠ADE = ∠AED, and ∴ AD = AE.

But AB = AC (Hyp.), ∴ DB = EC = ED. Q. E. D.

2. Parallelograms upon the same base, and between the same parallels, are equal to one another.

Prop. 35, Bk. I.

3. Equal triangles upon the same base and upon the same side of it are between the same parallels.

Prop. 40, Bk. I.

Algebra.

Answer two questions.

1. Square $1-3x+2x^2$, and divide $2x^5-2x^4+9x^3$ by $2x^3+x+1$.

(*a*)

$$\begin{array}{r} 1-3x+2x^2 \\ 1-3x+2x^2 \\ \hline 1-3x+2x^2 \\ -3x+9x^2-6x^3 \\ \qquad 2x^2-6x^3+4x^4 \\ \hline 1-6x+13x^2-12x^3+4x^4. \end{array}$$ Ans.

(*b*)

$$\begin{array}{r|l} 2x^3+x+1 & 2x^5-2x^4+9x^3 \\ & 2x^5+x^3+x^2 \\ \hline & -2x^4+8x^3-x^2 \\ & -2x^4 \quad -x^2-x \\ \hline & 8x^3 \quad +x \\ & 8x^3 \quad +4x+4 \\ \hline & -3x-4. \end{array}$$ Ans. Remainder.

2. Reduce to the lowest terms $\frac{p^2+mpq-mq^2-pq}{p^3-q^3+pq^2-p^2q}$

$$\frac{p^2+mpq-mq^2-pq}{p^3-q^3+pq^2-p^2q} = \frac{(p^2-pq)+(mpq-mq^2)}{(p^3-p^2q)+(pq^2-q^3)}$$
$$= \frac{p(p-q)+mq(p-q)}{p^2(p-q)+q^2(p-q)}$$
$$= \frac{p+mq}{p^2+q^2}.$$ Ans.

3. Solve :—

$$(1)\ x(x-a)+x(x-b)=2(x-a)(x-b)$$

$$(2)\ \frac{2}{2x-3}+\frac{1}{x-2}=\frac{6}{3x+2}$$

1) $x(x-a)+x(x-b)=2(x-a)(x-b)$

$x^2-ax+x^2-bx=2x^2-2bx-2ax+2ab$

$2x^2-2x^2-ax+2ax-bx+2bx=2ab$

$ax+bx=2ab$

$x=\underline{\frac{2ab}{a+b}}$ Ans.

(2) $\frac{2}{2x-3}+\frac{1}{x-2}=\frac{6}{3x+2}$

$\frac{2x-4+2x-3}{(2x-3)(x-2)}=\frac{6}{3x+2}$

$(4x-7)(3x+2)=6(2x-3)(x-2)$

$12x^2-13x-14=12x^2-42x+36$

$29x=50$

$x=\underline{\frac{50}{29}}$ or $\underline{1\frac{21}{29}}$ Ans.

Mensuration.

A ladder 40 feet long is placed so as to reach a window 24 feet high on one side of the street, and, on turning the ladder over to the other side of the street, it reaches a window 32 feet high; find the breadth of the street.

By making a diagram it is seen that the bases of two right-angled triangles are to be found.

Breadth of street $= \sqrt{40^2-24^2}+\sqrt{40^2-32^2}$

" " $= \sqrt{1600-576}+\sqrt{1600-1024}$

" " $= \sqrt{1024}+\sqrt{576}$

" " $= 32+24=\underline{56 \text{ ft.}}$ Ans.

Arithmetic.

FEMALES.

1. Find the value of ·163 of 2½ miles.

·163 × 2·5 = ·408 miles = 3 fur. 10 po. 3 yd. 2 ft. Ans.

8

3·26 fur.

40

10·6 po.

5·5

3·0 yd.

3

2·0 ft.

2. Reduce 6s. 6¾d. to the decimal of a guinea.

6s. 6¾d. / 21s. = 315 far. / 1008 far. = ·3125. Ans.

or 12)6·75d. 21)6·5625s. ·3125 gui. Ans.

3. Find a number which when multiplied by ·032 and divided by ·00016 produces 851.

No. = 851 × ·00016 ÷ ·032

= 851 × ·005

= 4·255. Ans.

4. Find a number which shall have to 3·75 the same ratio which 4 has to 5.

? : 3·75 :: 4 : 5

∴ No. required $= \frac{3\cdot75\times4}{5}$

$= \cdot75\times4=3$. Ans.

Grammar.

MALES AND FEMALES.

1. But when, *from* under this terrestrial ball,
He *fires* the proud tops of the eastern pines,
And darts his light in *every* guilty hole,
Then *murders*, treasons, and *detested sins*,
The *cloak* of night *being plucked from off* their backs,
Stand bare and naked.—RICHARD I.

Analyse the foregoing passage, parsing the words in italics.

2. Paraphrase it.

3. Pick out ten words of English origin in the passage, and explain the derivation of any of them.

ANALYSIS.

Sentence.	Kind.	Subj.	Predicate	Object.	Extensions.	Connective.
(1) But then murders, treasons, and detested sins, the cloak of night being plucked from off their backs, stand bare and naked.	Principal	murders treasons and detested sins	stand	bare and naked (completion)	then (time) the cloak of night being plucked from off their backs (time and reason)	but
(2) When, from under this terrestrial ball, he fires the proud tops of the eastern pines,	Subord. adv. to (1)	he	fires	the proud tops of the eastern pines	from under this terrestrial ball (place)	when
(3) and darts his light in every guilty hole.	Subord. adv. to (1)	(he)	darts	his light	in every guilty hole (place)	and

PARSING.

From—prep., forming part of the prep. phrase *from under*, gov. 'ball.'

fires—reg. trans. verb., indic. pres. indef., 3rd pers., sing., agr. with 'he.'

every—distrib. adj., qual. 'hole.'

murders—abst. noun, neut., plur., nom. subj. of 'stand.'

sins— " " " " "

detested—part. adj., qual. 'sins.'

cloak—com. noun, (here abst.), nom. absolute, agr. with 'being plucked.'

being plucked—incomplete part., pass. form with 'cloak,' nom. absolute.

from off—prep. phrase., gov. 'backs.'

stand—irreg. intrans. verb, *stand, stood, stood*, indic., pres. indef., 3rd pers. plur., agr. with 'murders, treasons, and sins.'

2. When the sun rises and day returns, the darkness, which may be compared to a covering, is lifted off, and those deeds which are done most successfully under the shadow of night are no longer concealed, but are immediately discovered.

3. Ten English words are :—'but' (*bi* and *utan*, 'be-out'), 'when' (O.E. *hwanan*); 'from' (O.E. *fram* or *fra*); 'under' (from root *in* with suffix *ther* = der); 'this' (O.E. *thes, theos, this*); 'he' (O.E. *he*); 'the' (*se, seo, thæt*); 'of' (O.E. *of, af, æf*); 'and' (O.E. *endi*); 'every' (compounded of *ever* and *each*, O.E. *æver-elc*).

4. What is the prefix in each of the following words :—Append, illegal, allude, co-heir, suggest, effect, deacon?

The prefix in 'append' is ap = ad; in 'illegal,' il = in; in 'allude,' al = ad; in 'co-heir,' co = con; in 'suggest,' sug = sub; in 'effect,' ef = ex; in 'deacon' there is none, though some derive it from the Greek, in which the prefix is dia, the whole word being dia-konos.

Geography.

(*Answer Questions* 1 *and* 2; *and the third if you have time.*)

1. Give full 'Notes of a lesson' on 'Land and Sea Breezes, explaining their nature, causes, and effects.

N.B.—In framing your notes, give your *chief* attention to the way in which you would place the facts before children. The facts alone, however full, will not count as good 'notes.'

LAND AND SEA BREEZES.

DEFINITION.—Land breezes blow from the land to the sea. Sea breezes blow from the sea towards the land. (*Illustrate from the draught of air from the room up the chimney, also from the currents of colder air from the outside into the room under the door; and that of the warmer air over the door.*)

CAUSE.—If sun shines on two tracts of surface, the one water and the other solid land, the latter becomes more rapidly heated

than the former, and at the end of the day will be found much warmer than the water. On the other hand, in the absence of the sun the land cools faster than the water, and at the end of the night it will be found below the temperature of the adjoining water. When the land is hottest, the air resting upon it will be hotter and lighter than the air over the sea, and the cold air from the sea will rush in upon the hot. (*Compare these effects with the hot air in the room (or over the fire), going through the chink at the top of the door (or up the flue), and the cold current coming in under the door and towards the fire.*) Thus during the day there will be a breeze from the sea to the land, and during the night a breeze from the land to the sea. These sea and land breezes are felt regularly on all sea-coasts when the other winds are not too strong.

EFFECTS.—On west coast of Africa, where the trade-winds do not blow, the sea breeze begins about 10 a.m., and is cool and pleasant, while the land breeze begins about 9 p.m., and is always laden with pestilential vapours. In South Africa (Cape Colony) no such disease as fever is known, from the fact that this part of the continent is thoroughly exposed to the sea-breeze which carries off the noxious vapours. (*Show position of Cape Colony.*) The islands of Cyprus and Ceylon have their heat moderated by the sea breezes.

2. Draw a full map of the Holy Land; and describe fully the peculiarities of the bed of the Jordan, and the lakes connected with it.

The bed of the Jordan is interrupted by twenty-seven considerable rapids, and by numerous islands which are scattered along it. The channel lies thirty or forty feet below the general level of the Jordan valley, and this channel when the river is swollen by rains, is completely filled, and often is unable to contain the pent-up flood.

The lakes connected with the Jordan are Lakes Samochonitis, Tiberias, and the Dead Sea. The lake of Tiberias is transversed by the river from N. to S., its waters are fresh and teem with fish; and it has now been ascertained that its surface is 653 feet below the level of the Mediterranean.

The Dead Sea or Lake Asphaltites is remarkable as being the saltest body of water known, with the exception of a lake in Asia Minor; the waters are so intensely salt that no living creature can live in them, and they are so buoyant that swimming in them is an easy accomplishment. Its surface is 1312 feet below the level of the ocean.

3. Describe the Sahara; and write out any anecdote you remember, to illustrate the dangers of travelling through it. If the ocean could be introduced, to cover it, what would be the effect on the climate of surrounding districts?

South of the Mediterranean and in Africa, lies the Great Desert, or Sahara, a great table-land rising in the middle to 4,000 feet above the sea. A wide tract in the west is said to be below the level of the ocean, and it has been proposed to cut a canal so as to introduce the waters of the Atlantic. The effect on that portion of Africa in the vicinity would be to mitigate the burning heat of the sun, and to bring rain to districts which only see it at intervals of five, ten, and fifteen years. As it is at the present time, the Sahara has no rivers, and the surface is covered with loose sand, gravel, or sharp rocks. Here and there, fertile spots occur called oases, which are watered by springs, at which travellers refresh themselves and their camels after their burning march. The sun beats down in summer, and the region is swept by hot winds, which often carry the stifling atmosphere to the shores of Europe. Travellers in the Sahara are often deceived by an optical delusion called the 'mirage,' presenting the appearance of a lake in which palm trees are reflected, and the sufferings of the disappointed are only augmented when he discovers the deception.

Anecdote.—A caravan was once crossing the desert, when suddenly an awful storm came. The wind blew fiercely and great clouds of sand were lifted into the air. The merchants at once got down from their camels, covered themselves with their cloaks and lay down, while the poor beasts closed their nostrils, and kneeling with their backs to the wind, waited till danger was past. When the storm had blown over they started again, thankful that none of them had been buried in the sand. This company was longer on its journey than had been expected, and their supply of water giving out, some of the camels had to be killed for the sake of the water in their stomachs.

SECOND PAPER.

Two hours and a half allowed.

Arithmetic.

MALES.

1. A grocer by selling tea at 2s. per lb. loses 4 per cent.; what would he gain or lose per cent. and per cwt. if he sells it at 2s. 3d. per lb.?

(*a*) That is he gets 96 hundredths out of 100.

∴ 24d. : 27d. :: 96 : the hundredths of price required.

$$\frac{96\times 27}{24} = 108 \text{ hundreths of price.}$$

That is, there will be a gain of 8 p.c. Ans.

(*b*) 96 : 100 :: 24d. : prime cost of 1 lb. or 25d.

∴ Gain on 1 lb. = 2d., and so the gain on 1 cwt. = 18s. 8d. Ans.

2. How can you tell by inspection when a number is divisible by 2, 3, 4, 5, 6, 8, or 11?

A number can be divided by 2 if the last figure is even; by 3 if the sum of its digits is divisible by 3; by 4 if the last two figures are divisible by 4; by 5 if the last figure be a cypher or 5; by 6 if the last figure be even, and the sum of the digits is divisible by 3; by 8 if the last three figures are divisible by 8; and by 11 if the difference of the sum of the digits in the odd places, and the sum of the digits in the even places, be 0, or exactly divisible by 11.

3. A man transfers £1500 stock from the three per cents. at 99⅓, and invests the money in 4½ per cent. debentures at 132¼; find the difference in his income, brokerage being charged at ⅛ per cent. on each transaction.

$$132\tfrac{1}{4}+\tfrac{1}{8} : 99\tfrac{1}{3}-\tfrac{1}{8} :: £1500 : \text{new stock}$$

$$\frac{£1500\times 99\frac{1}{3}}{133} = \frac{£1500\times 399}{133\times 4} = £1125$$

	£	s.	d.
∴ 2nd income $= \frac{£1125\times 4\frac{1}{2}}{100}$	= 50	12	6
1st ,, $= \frac{£1500\times 3}{100}$	= 45	0	0
Difference of income =	5	12	6. Ans.

4. Find the square roots of 823737·76 and $31\frac{69}{169}$.

(*a*)

```
| 823737·76 (907·6. Ans.
| 81
1807 | 13737
       12649
18146 | 108876
        108876
```

(*b*)

$$\sqrt{31\tfrac{69}{169}} = \sqrt{\frac{507+69}{169}}$$

$$= \sqrt{\tfrac{576}{169}}$$

$$= \tfrac{24}{13} = 1\tfrac{11}{13}. \text{ Ans.}$$

5. If the discount on a bill of £360 10s. be £10 10s., interest being at 4 per cent. per annum, in how many months will the bill be due?

	£
Present value of £360 10s.	= 350
,, ,, £104 for a year	= 100

∴ £350 : £100 :: £4 : £10½ :: 12 mos. : time

$$\frac{12\times 100\times 10\frac{1}{2}}{350\times 4} = 9 \text{ mos.} \quad \text{Ans.}$$

History.

MALES AND FEMALES.

1. When and how did it happen that England was willing to receive a king from Scotland?

According to the will of Henry VIII., the crown on the death of Elizabeth should have gone to the descendants of Mary, Duchess of Suffolk; but James VI. of Scotland, son of Mary Stuart (great grand-daughter of Henry VII.) was the nearest heir by birth. The nation was willing to accept him, and after his coronation an Act of Parliament was passed declaring his right.

2. Sketch the career of Oliver Cromwell.

Oliver Cromwell was the son of Robert Cromwell, and born at Huntingdon, 1599. He was returned as member for his native town to the third Parliament of Charles I., 1628. He was again elected in 1640. He was associated with Hampden,

Pym, and other popular leaders, and was one of the first to advocate resistance to the King's measures. In 1642 he received a captain's commission, and raised a troop of horse in his native county. So well were his soldiers disciplined, that after the battle of Marston Moor they got the name of Cromwell's Ironsides. At Naseby, Cromwell commanded the right wing, and Ireton, his son-in-law, the left. Charles was totally defeated in this battle, and ultimately gave himself up to the Scots at Newark. In 1649, when it was settled at his trial that the king should be executed, Cromwell is said to have reluctantly assented; but when convinced of the necessity of Charles's death, he seems to have had no hesitation in carrying the decision of the court into effect. After the execution, Cromwell became a principal member of the Council of State. He quelled a mutiny in the army, crossed over and conquered Ireland, returned to make war on Prince Charles and the Scots, whom he conquered at Dunbar and Worcester. In 1653 he expelled the Long Parliament, and was elected Protector of the Commonwealth, which office he held till his death in 1658.

Cromwell has now come to be regarded as one of England's greatest rulers. He was a man of most marvellous genius, who after the age of forty became an invincible general and a wise statesman. He was a zealous patriot, and an enthusiast in religion. To him are we indebted for the great lesson of religious toleration.

3. Who was the husband of Queen Victoria? Mention the alliances formed by Her Majesty's sons and daughters.

The husband of Queen Victoria was Prince Albert of Saxe-Coburg and Gotha.

ALLIANCES FORMED BY HER MAJESTY'S SONS.

Albert (Prince of Wales)	married	Princess Alexandra of Denmark.
Alfred (Duke of Edinburgh)	,,	Grand Duchess Marie of Russia.
Arthur (Duke of Connaught)	,,	Princess Louise Margaret, daughter of Prince Frederic Charles of Prussia.
Leopold (Duke of Albany)	,,	Princess Helene of Waldeck.

ALLIANCES FORMED BY HER MAJESTY'S DAUGHTERS.

Victoria (Princess Royal)	is married to	Prince Fred. William of Prussia.
Alice Maud Mary	was ,,	Prince Louis of Hesse Darmstadt.
Helena	is ,,	Prince Christian of Hesse Holstein.
Louise	is ,,	The Marquess of Lorne.

Teaching.

Write out simple notes of a lesson on *mountains*.

MOUNTAINS.

In giving the lesson, attention of children to be called to any hills in the vicinity of school, or reference to be made to maps or pictures of mountains, showing valleys, and streams in valleys.

WHAT ARE MOUNTAINS.—Mountains and hills are land rising above the level of the surrounding country; the height of a mountain being measured from the level of the sea; if less than 2000 ft. they are generally called hills, downs, fells, etc. (*Give instances on map.*)

HOW ARRANGED.—Mountains may be classified as *chains*, as the Pennine, Cheviots. *Groups*, as the Cumbrian Group. *Single peaks*, as Tinto Hill. *Burning mountains*, as Hecla.

PARTS OF A MOUNTAIN.—The *base* or foot; the *ascent* or slope; the *summit* or top; the *ridge* of a chain; *spurs* extending from a main chain.

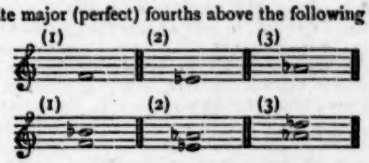
USES OF MOUNTAINS.—(1) Separate countries, as Cheviots, Pyrenees, Alps, Himalayas. (2) Rivers have their sources in mountains, as the Severn, Tweed, Clyde, etc. (3) Lakes are formed in mountain-valleys, as the lakes of Scotland, and those of the Lake District in the Cumbrian Hills. (4) They moderate the heat, as in tropical countries, or they cut off the cold, as the Alps protect the north of Italy. (5) They form health resorts, as in India. (6) Forest trees grow upon them, as the pines of Norway. (7) They are noted for their scenery, as the mountains of Scotland, Wales. (8) They form refuge in times of danger. (9) Mountains rather than Rivers form the barriers between nationalities, as the Vosges Mountains, and not the Rhine, form the real division between France and Germany.

Music.

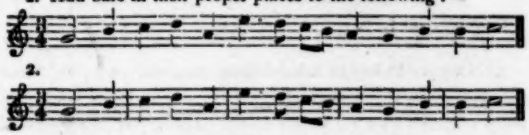
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write major (perfect) fourths above the following notes :—



2. Add bars in their proper places to the following :—



3. State (briefly) the meanings of the following terms :—(1) *Tempo primo*; (2) *Diminuendo*; (3) *Accelerando*.

3. (1) The same time as at the first; (2) Diminishing gradually the intensity or loudness of the tone; (3) Gradually increasing the speed.

TONIC SOL-FA NOTATION.

1. Write major (perfect) fourths above the following notes :—(1) *fah*; (2) *ta*; (3) *te*.

1. (1) *Fah* to *ta*; (2) *ta* to *ma*^{1}; (3) *te* to *me*^{1}.

2. Re-write the following, doubling the value of every note; use four-pulse measure :—

|d' :s .f |m .,r :f |m .r :d ‖

2. |d' :—|s :f |m :-.r|f :—|m :r |d :—‖

3. What do the following terms mean :—(1) *Tempo primo*; (2) *Diminuendo*; (3) *Accelerando*?

3. (1) The same time as at the first; (2) Diminishing gradually the intensity or loudness of the tone; (3) Gradually increasing the speed.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after,* **1st May, 1878; and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

FIRST PAPER.

Three hours and a half allowed.

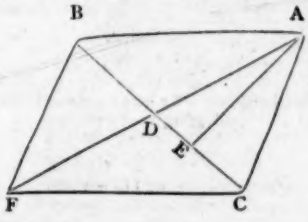
Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.

Answer two Questions, including Question 1, *if you can.*

1. The sum of the squares on the sides of a parallelogram is equal to the sum of the squares on the diagonals.



Let BACF be a ▭, then the sum of the sqs. on the sides = sum of the sqs. on the diagonals BC, AF.

Because AB is ∥ FC, ∠s DBA, DCF are equal, as also ∠s DAB, DFC, and the side BA=FC. ∴ △s BAD, FDC are (I. 26) equal in every respect. ∴ BD=DC, and FD=DA. ∴ The diagonals bisect each other.

Draw AE perp. to BC.

Then in the obtuse-angled △ ABD (II. 12), sq. on AB exceeds sqs. on AE, DB by 2 BD.DE, and by II. 13, the sq. on AC is less than the sqs. on AD, DC by 2 CD.DE. ∴ Since rect. BD.DE=rect. CD.DE, it follows that the sqs. on AB, AC are double of the squares on AD, DB. In the same manner it may be shown that the sqs. on BF, FC are double the sqs. on FD, DC, *i.e.*, double the sqs. on AD, DB. ∴ The sqs. on BA, AC, CF, FB=4 times the sqs. on AD, DB, that is=the sqs. on BC, AF. Q. E. D.

2. To describe a square upon a given straight line.

Prop. 46, Bk I.

3. If a straight line be divided into two equal parts, and also into two unequal parts, the rectangle contained by the unequal parts, together with the square on the line between the points of section, is equal to the square on half the line.

Prop. 5, Bk. II.

Algebra.

Answer two Questions.

1. There are two numbers in the ratio 3 : 5; if 10 be added to the first and taken from the second, the ratio is reversed. Find the numbers.

If x = the one, then the other = $\frac{5}{3}x$.

$\therefore x+10 : \frac{5}{3}x-10 :: 5 : 3$,

or $3x+30=\frac{25x}{3}-50$ (product of extremes = prod. of means)

$9x+90=25x-150$

$16x=240$

$x=\underline{15}$ one number. Ans.

$\frac{5}{3}x=\frac{75}{3}=\underline{25}$ the other. Ans.

2. Simplify $\frac{a+b}{a-b}+\frac{a^2-b^2}{a^2+b^2}-\frac{a^2+b^2}{a^2-b^2}$.

$$\frac{a+b}{a-b}+\frac{a^2-b^2}{a^2+b^2}-\frac{a^2+b^2}{a^2-b^2}=\frac{(a+b)(a+b)-(a^2+b^2)}{a^2-b^2}+\frac{a^2-b^2}{a^2+b^2}$$

$$=\frac{2ab(a^2+b^2)+(a^2-b^2)(a^2-b^2)}{(a^2-b^2)(a^2+b^2)}$$

$$=\underline{\frac{a^4+2a^2b^2-2a^2b^2+2ab^3+b^4}{a^4-b^4}}. \text{ Ans.}$$

3. Solve—

$$(1)\ \begin{cases}\frac{7x+6}{11}+y-16=\frac{5x-13}{2}-\frac{8y-x}{5}\\ 3(3x+4)=10y-15\end{cases}$$

$$(2)\ \frac{5x-2}{3x+1}=\frac{3x+10}{4x-5}$$

(1) (*a*) $\frac{7x+6}{11}+y-16=\frac{5x-13}{2}-\frac{8y-x}{5}$

$70x+60+110y-1760=275x-715-176y+22x$

$275x+22x-70x-110y-176y=715+60-1760$

$227x-286y=-985.$

(*b*) $3(3x+4)=10y-15$

$9x-10y=-27.$

from (*b*) (multiplying by 286) $2574x-2860y=-7722$

from (*a*) (multiplying by 10) $\underline{2270x-2860y=-9850}$

By subtraction $304x = 2128$

$x = \underline{7}$. Ans.

and $\therefore y = \underline{9}$. Ans.

(2) $\frac{5x-2}{3x+1}=\frac{3x+10}{4x-5}$

(clearing of fractions) $20x^2-8x-25x+10=9x^2+30x+3x+10$

collecting $11x^2-66x=0$

$x(11x-66)=0$

$\therefore x=\underline{0}$

or $11x-66=0$

$11x=66$

$x=\underline{6}$

Hence $x=\underline{6}$ or $\underline{0}$. Ans.

Mensuration.

A road runs round a circular shrubbery; the outer circumference is 500 feet and the inner 420 feet; find the area of the road.

$$\text{Area of a circle} = \frac{\text{radius} \times \text{circumference}}{2}$$

Now radius of outer circle $=\frac{250}{3{\cdot}1416}$,

and ,, inner ,, $=\frac{210}{3{\cdot}1416}$

$\therefore$ area of outer circle $=\frac{125\times500}{3{\cdot}1416}=\frac{62500}{3{\cdot}1416}$ (*a*)

and ,, inner ,, $=\frac{105\times420}{3{\cdot}1416}=\frac{44100}{3{\cdot}1416}$ (*b*)

Hence the difference between (*a*) and (*b*) = area of road.

$$=\frac{62500-44100}{3{\cdot}1416}$$

$$=\frac{18400}{3{\cdot}1416}$$

$=\underline{5857}$ sq. ft. Ans.

Arithmetic.

FEMALES.

1. Find the simple interest and amount of £325 15s. 5d. for 4 years at 5 per cent. per annum.

Simple interest $=\frac{£325\ 15s.\ 5d.\times4\times5}{100}$

$=£325\ 15s.\ 5d.\div5=\underline{£65\ 3s.\ 1d.}$ Ans.

Amount = £325 15s. 5d. + £65 3s. 1d. = $\underline{£390\ 18s.\ 6d.}$ Ans.

2. If 30 men do $\frac{3}{4}$ of a piece of work in 12 days, working 8 hours a day, in what time will $\frac{3}{5}$ of the same piece of work be done, if half the number of men are taken off after the first day?

30 men do $\frac{3}{4}$ in 12 days.

or 30 ,, ,, $\frac{1}{40}$ in 1 day.

and 15 ,, ,, $\frac{1}{80}$ in 1 ,,

$\therefore$ 15 men will do $\frac{3}{4}-\frac{1}{80}$ or $\frac{45-2}{60}$ in 43 days.

Hence the $\frac{3}{4}$ will be done in 1 day + 43 days = $\underline{44}$ days. Ans.

3. Find the income obtained by investing £50,000 in the $3\frac{1}{2}$ per Cents. at 98, and the loss on selling out at $96\frac{3}{4}$.

£98 : £50,000 :: $3\frac{1}{2}$: Required income.

$£\frac{50000\times3\frac{1}{2}}{98}=£\frac{175000}{98}$ or $£\frac{12500}{7}$

$=\underline{£1785\ 14s.\ 3\frac{3}{7}d.}$ Ans.

£98 : £50000 :: £$(98-96\frac{3}{4})$: Loss required.

$£\frac{50000\times1\frac{1}{4}}{98}=£\frac{625000}{98}$ or $£\frac{312500}{49}$

$=\underline{£637\ 15s.\ 1\frac{11}{49}d.}$ Ans.

4. Find the average of 13, 27, 0, 32, 106, 86.

Average = the sum of the parts divided by the number of them

$=\frac{13+27+0+32+106+86}{6}$

$=\frac{264}{6}=\underline{44}$. Ans.

Grammar.

MALES AND FEMALES.

1. The *manner*, *circumstances*, and *conclusion* of that voyage, with the rare accidents which happened in it, will *no doubt* be *at large remembered by whosoever* shall *have* the courage to write the transactions of that time, with *that* integrity he *ought* to *do*: in *which* it will manifestly appear, *how much* of the prophet was in the wisdom of the king.—Clarendon's *History of the Rebellion*.

Analyse the above, parsing the words in italics.

2. Make a list of the words in it derived from Latin roots.

3. To what period of our literature does it belong? Mention any other writers in the same century and their works.

ANALYSIS.

Sentences.	Kind.	Subject.	Predicate.	Completion.	Extensions.	Connectives.
(1)						
The manner, circumstances, and conclusion of that voyage, with the rare accidents . . . will no doubt be at large remembered by (him).	Principal	the manner, etc. .....accidents	will be remembered		no doubt (*manner*) at large (*degree*) by (him) (*complement*)	
(2)						
Which happened in it	Adj. to 'accidents.'	which	happened		in it (*place*)	which
(3)						
Who shall have the courage to write the transactions of that time with that integrity	Adj. to (him)	who	shall have	the courage (*object*) to write, etc.....integrity		who
(4)						
(With which) he ought to do (it):	Adj. to 'integrity'	he	ought	to do (it)	with which (*manner*)	(which)
(5)						
In which it will manifestly appear,	Principal	it	will appear		manifestly (manner) in which (*place*)	(which)
(6)						
How much of the prophet was in the wisdom of the king.	Noun in apposition with 'it'	how much of the prophet	was (incomplete)	in the wisdom of the king		how

PARSING.

Manner conclusion } abst. nouns, neut. sing. nom., subj. of 'will be remembered.'

circumstances—abst. noun, neut., plur., nom., subj. of 'will be remembered.'

no doubt—adv. phrase manner, mod. 'will be remembered.'

at large— ,, ,, ,, ,, ,, ,,

remembered—complete part., forming part of compound tense 'will be remembered,' predic. of 'manner, etc.'

by—prep., gov. obj. case (him), at present day the pronoun would be 'whomsoever.'

whosoever—rel. pron., antecedent suppressed, nom., subj. of 'shall have.'

have—irreg. trans. verb, *have, had, had*, infin., pres. indef., gov. by 'shall.'

that—demonst. adj. pron., dist. 'integrity.'

ought—irreg. intrans. verb defect., originally belonged to the verb 'owe,' now used only as a pres. or past according to the verb which follows it; here it is pres., because 'to do' is pres.

do—irreg. trans. verb, *do, did, done*, infin. pres., gov. by 'ought.'

how—adv. of deg. mod. 'much.'

much—adj. of quantity used as a noun, nom., subj. 'was.'

2. The words derived from Latin are:—circumstances, conclusion, rare, accidents, doubt, remembered, transactions, integrity, manifestly, appear; voyage, courage, time, from Latin through the French.

3. The passage belongs to the modern period of our literature (the seventeenth century).

Other writers of the same century are *Milton*, who wrote 'Paradise Lost;' *Jeremy Taylor*, 'Holy Living and Holy Dying;' *Samuel Butler*, 'Hudibras;' *John Dryden*, 'Absalom and Ahithophel;' *John Bunyan*, 'The Pilgrim's Progress;' *Sir Isaac Newton*, 'Principia and Natural Philosophy;' *John Locke*, 'Essay on the Human Understanding.'

Geography.

(*Answer two Questions.*)

(*Answer Q. 1 and 2, and No. 3, if you have time.*)

1. Give 'Notes of a Lesson' on 'The Phases of the Moon.' Illustrate by a diagram or diagrams.

THE PHASES OF THE MOON.

Diagram showing the phases of the Moon at the end of each eighth part of her course, with the Earth in the centre; Sun also in position.

Words to be written on blackboard and explained as they occur.

MOONLIGHT.—The light of sun falling upon the moon is partly absorbed, but a portion is reflected and becomes what we call *moonlight*. The illuminated part, from which we derive moonlight, is always increasing or diminishing to our eyes, as the moon proceeds in its revolution round the earth.

PHASES.—Phases mean appearances. When the moon is on the opposite side of the earth from the sun (in *opposition*), we, being nearly between the two, see the whole of the illuminated part, which we call *full moon*. As the moon advances we gradually lose sight of the illuminated portion, and the moon is said *to wane*. At length, when she has got between the earth and the sun, or into *conjunction*, we lose the luminous side, and the moon is said *to change*. Proceeding onwards, she soon turns her bright edge towards us, and the *new moon* is seen. This gradually *waxes* larger, till she is one quarter of her circuit from the sun and in *quadrature*, and the disc shows what we call *half-moon*. The luminary, when on the increase from *new* to *half*, is termed *crescent;* and when between *half* and *full*, *gibbous* (humpbacked).

Note.—The appearance called 'the old moon in the new moon's arms' is produced by the reflection of the sun's light from the earth.

2. Draw a full map of Central America; show where a canal may possibly be cut between the two oceans, and say what would be the use of it.

Insert the lines of latitude and longitude.

If a canal is ever cut between the Atlantic and the Pacific, it will be cut through the Isthmus of Panama, which has been repeatedly surveyed with the object of finding a route for a canal to connect the two oceans, and practical operations have indeed commenced with that object.

The importance of a canal to the trade between European commercial countries, such as Britain, France, Germany, Italy, and the ports on the Pacific coast, and in as great a degree to the United States, is apparent from the great increase in the trade of these ports since the working of the railroad commenced. The route from Britain to her Australian colonies by Panama would almost lie in a straight line, and save at least 2000 miles. The long and dangerous voyage round Cape Horn would also be saved.

3. Show, as you would to an intelligent child, with a globe before you, the different ways of going from London to New Zealand by sea.

In sailing from London to New Zealand we pass down the British Channel, down through the middle of the Atlantic Ocean, having Africa on our left and America on our right. Doubling Cape Horn, we skirt the South Pacific, and reach New Zealand, after a voyage of nearly 13,000 miles.

Second Route.—Leaving London, we pass down the British Channel through the Bay of Biscay, past Spain and Portugal, coast south along Africa, touch at St. Helena, double the Cape of Good Hope, and proceed eastwards along the south limit of the Indian Ocean through Bass Strait to New Zealand, after a voyage of scarcely 13,000 miles.

Third Route.—Proceed down the British Channel, Bay of Biscay, past Spain and Portugal, through the Straits of Gibraltar, Mediterranean Sea, Suez Canal, Red Sea, touch at Aden, through the Arabian Sea to Ceylon, south-east through the Indian Ocean to Australia, and along the south coast of Australia, through Bass Strait, to New Zealand.

SECOND PAPER.

Arithmetic.

Two hours and a half allowed

MALES.

1. A grocer mixes three sorts of tea in the proportion of 2 lb. at 2s., 3 lb. at 2s. 4d., and 4 lb. at 2s. 6d, and sells the mixture at 2s. 8d. per lb. ; find the gain per cent.

		s.	d.	s.
2 lbs.	at	2	0	= 4
3 ,,	,,	2	4	= 7
4 ,,	,,	2	6	=10
∴ 9 lbs.		cost		21

but 9 lbs. are sold for 2s. 8d. × 9 = 24

gain on 21s. = 3

∴ 21 : 100 :: 3 : gain p. c.

$\frac{3 \times 100}{21} = 14\frac{2}{7}$. Ans.

2. How much 3 per cent. stock at par must a man sell in order to purchase enough of 4 per cent. stock at $124\frac{1}{2}$ to produce an income of £399 10s., the usual brokerage being charged on each transaction ?

$100 - \frac{1}{2}$ or $99\frac{1}{2}$ is got from £100

1 ,, ,, $\frac{100}{99\frac{1}{2}}$

$124\frac{1}{2} + \frac{1}{2}$ or 125 ,, ,, $\frac{12500}{99\frac{1}{2}} = \frac{100000}{799}$

∴ 4 : $399\frac{1}{2}$ :: $\frac{100000}{799}$: Amount sold.

$\frac{100000 \times 399\frac{1}{2}}{799 \times 4} = \frac{£100000 \times 799}{799 \times 4 \times 2}$

$= 12500$ Ans.

3. If 23,328 soldiers be drawn up in the form of a rectangle, with twice as many ranks as files, how many ranks and files were there ?

The above arrangement = two squares of 11,664 men each.

∴ $\sqrt{11664} = 108$ the files

and ∴ the ranks = 216. Ans.

4. If a woman, by selling eggs at 16d. per dozen gains 8 per cent., how many must she sell for 10s. to gain 20 per cent. ?

16d. is the selling price of 12 eggs to gain 8 p. c.

∴ 1d. ,, ,, $\frac{3}{4}$,, ,,

120d. ,, ,, 90 ,, ,,

∴ 120 : 108 :: 90 : No. required.

$\frac{90 \times 108}{120} = 81$. Ans.

History.

MALES AND FEMALES.

1. How did the reigning dynasty obtain the throne ?

Our present Queen Victoria belongs to the House of Brunswick, and is lineally descended from George I., who was the first of the dynasty.

George I., who became king of England in 1714, was the great-grandson of James I. Elizabeth, daughter of James I., had married Frederick, the Elector Palatine, and their daughter Sophia was the mother of George I.

By the Act of Settlement (1701) it was arranged that the sovereigns of England should be Protestants in communion with the Church of England, and that the Electress Sophia of Hanover, and her heirs (if Protestants), should succeed to the crown of England.

George I. accordingly under this arrangement ascended the throne.

2. Can you mention periods of our history which show that excessive power gained by one class or individual has been followed by reaction and reverse ?

The power of the Church and that of the barons and land-owners had been growing for centuries, until the people could bear the tyranny no longer, and almost about the same time a reaction set in against them. In the reign of Richard II., Wycliffe had founded a sect called Lollards, declaring that the Church might justly be deprived by the king or lay-lords of its property for defect of duty. He was still working hand in hand with John of Gaunt in Church reform, when the great insurrection of peasants broke out under Wat Tyler. This rebellion was caused by the landlords falling back upon their half-forgotten rights over the villains, and recalling to servitude many a man who had hitherto been as good as free. The revolt ended in the almost total abolition of villainage.

Among other instances from English history may be noted the parliamentary struggle with James I. and Charles I. against their arbitrary power, ending in the overthrow of monarchy and the establishment of a Commonwealth. A reaction set in even against this Commonwealth, for its Protector, by the assumption of tyrannical powers, so disgusted the nation, that it returned to monarchy. From the strict religious discipline of the Puritans Charles II. led the way into the opposite extreme. All that was noblest and best in Puritanism was hurled away, religion fell with the fall of the Puritans, and godliness became a by-word of scorn. It is easy, however, to exaggerate the extent of this re-action, which in its more violent forms was practically confined to the capital and the court.

Modern history gives ample proof of the above fact, for no sooner is one party settled in the government than the opposing party strives to create a reaction in its own favour by holding up to the nation the danger to the State from the powers of the other.

3. Whom would you name as the most celebrated writers of poetry and prose under Elizabeth, Anne, and Victoria ?

UNDER.	POETS.	PROSE WRITERS.
Elizabeth	Sir Thomas Wyatt. Earl of Surrey. Edmund Spenser. William Shakspere. Ben Jonson. Beaumont and Fletcher.	Lord Bacon. Sir Philip Sydney.
Anne	Pope. Matthew Prior.	Addison. Richard Steele. Daniel De Foe. Swift.
Victoria	Browning. Tennyson. Swinburne. Mrs. Browning.	Thackeray. Dickens. Lytton. Kingsley. Carlyle. Ruskin. Macaulay.

Teaching.

Sketch out notes of a lesson, with examples, showing the difference between transitive and intransitive verbs.

TRANSITIVE AND INTRANSITIVE VERBS.

Let such phrases as the following be written on the black-board :—'Tom struck' ; 'James cut' ; 'the dog bit' ; and ask the children to complete the meaning by adding nouns or pronouns (the change in the form of pronouns suiting well for showing the object). 'Tom struck *him* (or *the boy*)' ; 'James cut *his finger*' ; 'the dog bit *her*, *us*, or *them*,' etc.

Take another series of verbs, such as 'tremble,' 'rave,' 'sing,' 'flow,' etc., and show that these words can be used without any object, as : 'The leaf trembles' ; 'the wind raves' ; 'the old man talks' ; 'the girl sings' ; 'the river flows.'

Now explain that 'transitive' means a passing over of the action from the subject to the object ; and that 'intransitive' means a confining of the action to the subject.

Show also that some verbs are sometimes transitive and sometimes intransitive, as : To paint a picture, to paint ; to drive a horse, to drive ; to hear a sound, to hear.

Music.

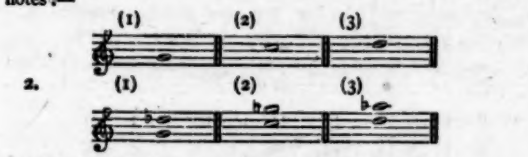
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

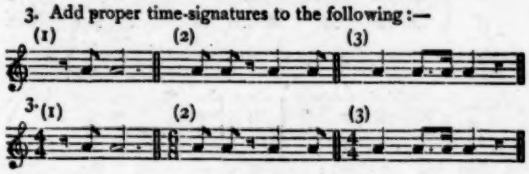
1. Write in the treble clef the ascending scale of D minor, using the minor sixth and the sharp seventh, placing the necessary flats, &c., before the notes.

1.

2. Write minor or diminished fifths above the following notes :—



3. Add proper time-signatures to the following :—



TONIC SOL-FA NOTATION.

1. Write the ascending minor scale from *lah*$_1$ to *lah*, using the minor sixth and the sharpened seventh.

1. *lah*$_1$ *te*$_1$ *doh ray me fah se lah*

2. Write the minor or diminished fifths above the following notes :—(1) *me* ; (2) *te*$_1$; (3) *ray*.

2. (1) *me* to *ta* ; (2) *te*$_1$ to *fah* ; (3) *ray* to *la*.

3. Re-write the following, halving the value of every note ; use two-pulse measure :—

$$|\text{m} :\text{-.f}|\text{s} :\text{f} \quad |\text{m} :\text{-.f}|\text{r.t}_1\text{:d} \;\|$$

3.

$$|\text{m} .\text{f} :\text{s} .\text{f} \quad |\text{m} .\text{f} :\text{r}, \text{t}_1.\text{d} \;\|$$

BOTANY IN INDIA.—We learn the following details as to botanical progress in India; the sources of information are Dr. King's Annual Report of the Royal Botanic Garden, Calcutta, for the year 1882-3, and Mr. J. F. Duthie's Report of the Government Botanical Gardens at Sharunpur and Mussoorie for the year ending March 31st, 1883. At Calcutta great improvements have been made in the general accommodation of the garden, as well as in the more specially scientific department. As usual much attention has been paid to plants important from a commercial point of view, especially those which produce india-rubber. The soy bean of Japan also (*Glycine soja*) has been introduced, and is to receive an extensive trial, though Dr. King seems doubtful of its success. The Lloyd botanic garden at Darjeeling has been devastated by an invasion of cockchafer grubs; nearly every plant outside in the garden has been killed, and those in the conservatories have not altogether escaped. It is satisfactory to know that by the energetic action of the authorities the plague seems to be disappearing. In Mr. Duthie's Report economic plants again occupy the most prominent place, while medical plants and the preparation of drugs from them is not forgotten. Amongst the latter we find Alexandrian senna (*Cassia acutifolia*), henbane (*Hyoscyamus niger*), belladonna (*Atropa belladonna*) etc.

Publications Received.

Chambers (W. and R.)—

The Imperial Algebraic Test Cards. Stages 1, 2, and 3.
French Course. First Year. By Hector Rey.

Gage and Co. (Toronto)—

The Canada School Journal. November.

Griffin and Co.—

An Explanatory Arithmetic. By G. Eastcott Spickernell.

Heywood (John)—

Gardiner's Explanatory Geography. Part III. for Standard IV.
Breathing. By A. Ransome, M.D., M.A.
The Manchester Readers. Book III.
Prince's School Management and Method.
Third Paragon Reader.

James Maclehose and Sons—

Latin Prose Exercises. By G. G. Ramsey, M.A., LL.D.
The Naturalist's World. Vol. I., No. 1.

Johnston (A.)—

Map of British North America.
Johnston's Standard Map of the British Empire.

Longmans and Co.—

Longman's Magazine. No. 14. December.
Supplementary Book-keeping by Double Entry. By Rev. J. Hunter, M.A.
Manual of Short Methods in Arithmetic. By the Rev. J. Hunter, M.A.

Longmans, Green and Co.—

Ganot's Popular Natural Philosophy. By E. Atkinson, Ph.D., F.C.S.

Marcus Ward and Co.—

Tales from Shakspeare. By Charles and Mary Lamb.

Philip (G. and Son).—

The Story of Early Exploration. Science Ladder. No
Philips' Standard Poetry Book. No. 5.

Samuel Amery—

Allen's Patent Flexible Studs.

Stanford (E.)—

Needlework and Cutting-out. By Kate Stanley.
A Short History of Natural Science. By A. B. Buckley

Swan Sonnenschein and Co.—

Biographical Stories. By Nathaniel Hawthorne.
Birds and their Ways. By J. S. Armstrong.
Madge Hilton. By A. C. Maitland.
The Great Composers. By C. E. Bourne.
Life of Lady Russell. By F. P. G. Guizot.
Celebrated Women Travellers. By W. H. D. Adams.
Life of Sir Walter Raleigh. By F. L. Clarke.
The Boys of Raby. By F. A. White.
Battle Stories. By W. H. Davenport Adams.

Smith, Elder and Co.—

The Cornhill Magazine. No. 6. December.

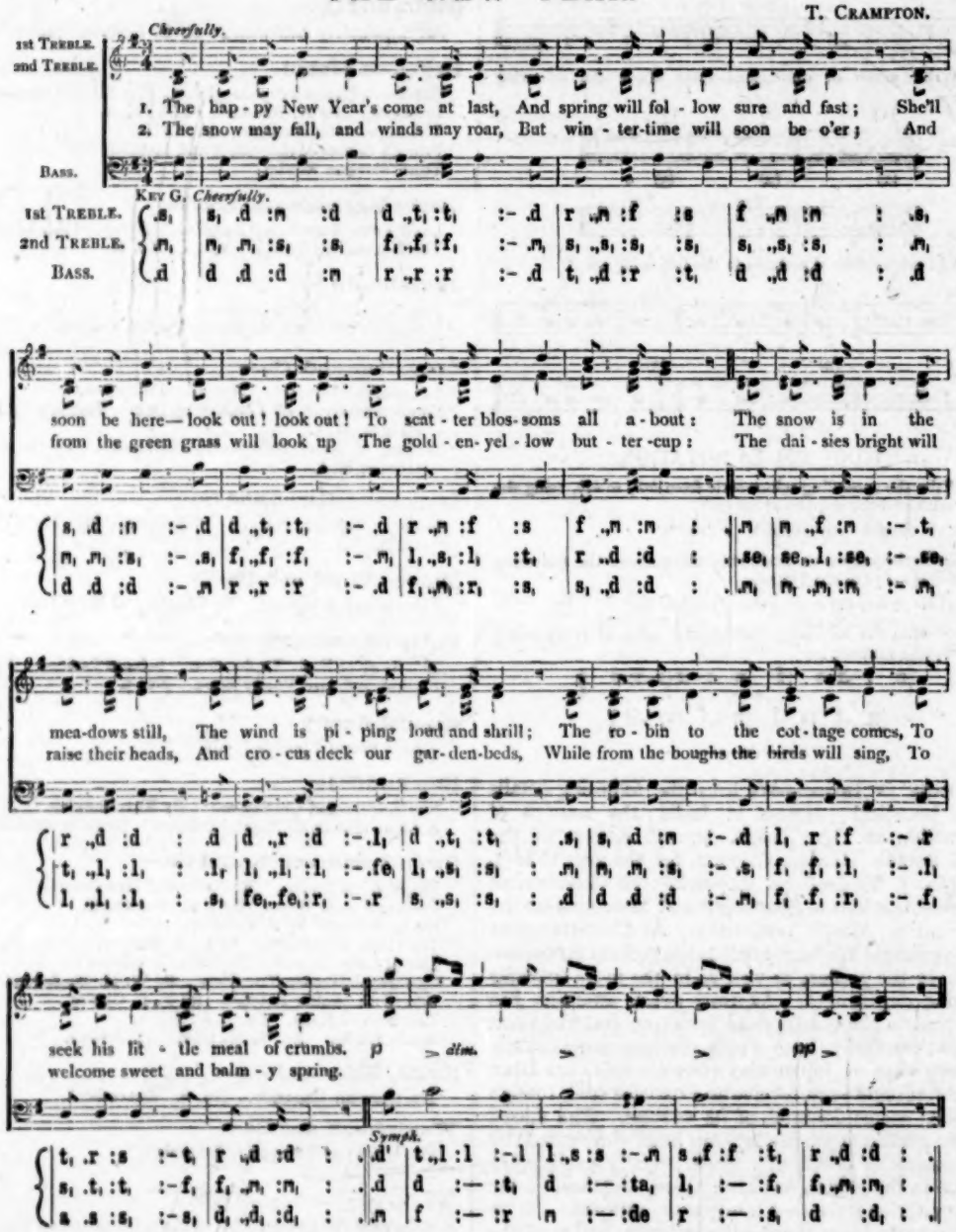
Ward, Lock, and Co.—

The Universal Instructor, December.

SEWAGE WATER.—M. Balland points out that water suspected of sewage contamination may be tested by pouring into a long tube a few cubic centimetres of a solution of sodium hypobromite and filling up the tube with the water. If the tube be then inverted into a vessel of mercury, and if urea be present, nitrogen will rise in bubbles, and accumulate at the upper end of the tube.

THE NEW YEAR.

T. CRAMPTON.


Cheerfully.
1st Treble.
2nd Treble.
Bass.
1. The hap - py New Year's come at last, And spring will fol - low sure and fast; She'll
2. The snow may fall, and winds may roar, But win - ter-time will soon be o'er; And
KEY G. Cheerfully.
soon be here—look out! look out! To scat - ter blos - soms all a - bout: The snow is in the
from the green grass will look up The gold - en - yel - low but - ter - cup: The dai - sies bright will
mea-dows still, The wind is pi - ping loud and shrill; The ro - bin to the cot - tage comes, To
raise their heads, And cro - cus deck our gar-den-beds, While from the boughs the birds will sing, To
seek his lit - tle meal of crumbs.
welcome sweet and balm - y spring.
p
dim.
pp
Symph.

The Practical Teacher.

A MONTHLY EDUCATIONAL JOURNAL.

To Subscribers.—The *Practical Teacher* is published on the 25th of every month. Price 6d.; post free, 7½d.; sent post free, three months for 1s. 11d.; six months, 3s. 9d.; a year, 7s. 6d.

P. O. Orders should be made payable at Chief Office.

Subscribers not receiving their copies regularly are respectfully requested to write to the Publisher.

It would save time and expense if subscribers when remitting would state exactly what numbers they wish to be sent.

To Correspondents.—All literary communications should be addressed, THE EDITOR OF THE PRACTICAL TEACHER, Pilgrim Street, Ludgate Hill, London, E.C.

Accepted contributions are paid for within twenty-one days of publication.

The Editor cannot return rejected MSS.; authors should therefore retain copies.

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Portfolios, fitted with elastic bands, for preserving twelve numbers of 'The Practical Teacher,' may now be had. Price 2s. 6d. Orders should be given through booksellers.

Vol. I. of the *Practical Teacher* is now out of print.

Publications Reviewed.

MESSRS. SWAN SONNENSCHEIN AND CO.'S PRIZE BOOKS.

The books forwarded to us by Messrs. Sonnenschein have all the attractions which the publishers can give to their volumes. Even the cheapest are daintily bound, the illustrations and the type are good, and the general aspect of the books is accordingly handsome.

The Great Composers. By C. E. Bourne.

Mr. Bourne gives here the lives of most of the great composers who are no longer living, beginning with Handel and ending with Berlioz. He supplies an excellent outline of the career of each great musician, and a brief indication of the character of most of their noted compositions. The literary style in which the book is written is good. Anecdotes are interwoven in the text, and the characteristics, both of the men and of their works, are well displayed. Mr. Bourne acknowledges his debt to Sir George Grove's 'Dictionary of Music,' and he has good cause to do so. Still, the credit of originality in arranging his matter, and in critical observation, is due to Mr. Bourne. His volume is by no means a piece of mere book-making. Portraits of nearly all the composers of whom he treats are given, and each biography is introduced by an interesting excerpt from a eulogy passed on the subject of it by some other eminent composer. We cordially recommend Mr. Bourne's attractive and well-written work to all interested in musical or biographical studies.

Celebrated Women Travellers. By W. H. D. Adams.

This is a piece of industrious book-making from the works of travel of a number of ladies. The names form a heterogeneous assortment, ranging from those of really famous travellers, such as Ida Pfeiffer and Miss Isabella Bird, through others, celebrated indeed, but in quite other ways than as travellers, such as Harriet Martineau and Frederika Bremer, down to some insignificant persons who have made a journey to Constantinople or Australia, and written a book about it. Brief snatches of description are extracted from the works of these several ladies. In the case of the Englishwomen who had a good style, these quotations are, of course, readable; in the case of the Frenchwomen, whose writings Mr. Adams has had to translate, the quotations remain at the dead level of the rest of the book. But in every instance, the quotations are necessarily so fragmentary as to afford no idea of any kind to the reader that is worth the undertaking of reading the book. Neither the literary style of the travellers nor the character of the country in which they travelled can be in any degree discovered from these extracts, which are not connected together in any way, but are apparently selected quite at random. Such remarks as are offered as original are trite in the extreme. When Mr. Adams' knowledge of the authors from whom he conveys his quotations is gained from a review of their books in the *Revue des Deux Mondes*, nothing can exceed the fulsome eulogy he pours forth about their (often very small) achievements, especially when there is a foreign title in the case. But when he comes to speak of his own greater countrywomen, of whose lives the newspapers have told him something, the patronising tone which he adopts is even more offensive. He feels personally injured when Lady Brassey describes only what she saw at Athens, and so squanders the opportunity of making several pages of a book out of that ancient history which every schoolboy knows, or which any school-book on Greece would supply. As Lady Brassey misses this chance, her writing is contemptuously described as 'ambling on,' and she is told that 'her reflections are not less commonplace than her style.' Other ladies receive no better treatment from Mr. Adams. Mrs. Trollope is 'rough and coarse;' Miss Martineau has 'colossal egotism and self-sufficiency;' Lady F. Dixie's style has 'no special literary merit,' and so on. Mr. Adams' qualifications to judge the work of such women may be gauged from a sentence or two extracted almost at random from his share in the book. This is *style*:—'Carlyle has a remark to the effect that from the way in which a man, of some wide thing that he has witnessed, will construct a narrative, what kind of picture and delineation he will give of it, is the best measure we can get of the man's intellect.' And this, we suppose, is

reflection :—'In 1835 the Parisians sometimes fell to blows in support of a philosophical principle, and would incur almost any hazard to hear a favourite orator or to "assist" at the representation of a drama by one of their own pet authors. Half a century later, and they hurry to horse-races, and fight one another for a caprice.' If this 'reflection' means anything, it means the reverse of the truth. On the same page there is the shockingly ignorant error committed of translating the French 'positif' (*i.e.*, the *practical*) as 'Positivism,' and so making Mrs. Trollope say that the introduction of Positivism into French *salons* caused a diminution in good manners. It is our duty thus to point out the extreme slovenliness with which this work is compiled, and to add that there are passages in it which seem to show that it was not designed for children. Such are the account of the jealous murder of a wife's lover by a Russian baron, and the description of the 'languid,' 'lustrous,' 'liquid' eyes of an 'Oriental Venus,' 'perfect of their kind, and at least as dangerous to the senses' as an Englishwoman's heaven of blue. It would be an insult to offer this volume to a cultivated woman.

Battle Stories from English and European History. By W. H. D. Adams.

This book, although the work of the same writer as the one above reviewed, is of a very superior character. The nature of the subject has here compelled a certain amount of finish, and of cohesion between the parts of each chapter. Moreover, the authors who are followed have rarely had to be translated, and amongst them are some, such as Mr. Kinglake, who are masters of a magnificent English style. The stories of courage and heroism which we here meet with are calculated to delight the heart of every boy with fibre in him. The book has, besides, a distinct educational value. It makes history more real, and leads one to understand those details which considerations of dignity and of space lead most great historians to ignore. The detailed story of the wars which have influenced the course of the world's affairs is spread over many volumes, and has never been so gathered together and collected as here by Mr. Adams. We have, therefore, to thank him for having done a valuable and useful work with much judgment and discretion. These pages are full of interest and vigour, and will be eagerly read by most young people; while Hastings, Agincourt, Cressy, Inkerman, and all the rest of the battles here recorded, will become real events, instead of mere names, to the readers of this book, and consequently the historical studies which show how these fights came to be fought, and which tell what were their ultimate results, will be more willingly and intelligently pursued.

Madge Hilton. By Agnes C. Maitland.

We have pleasure in drawing the special attention of those of our readers who are seeking prize books for girls to this charming story. Madge, who gives her name to the book, is one of a large family, boys and girls, all of whom are clearly and well drawn. They quickly become familiar personages to the reader, and are as good company as a lot of healthy, well-disposed youngsters can possibly be. The elders are equally distinct individualities. The mother and father, the two governesses, Aunt Eliza, and Uncle Harry, are all, however sketchy, thoroughly definite and real characters. Some of the children's gossip reads as though taken from life. There is plenty of incident in the story, too, of a natural, healthy kind. Madge should not be quite so faultless; she is a trifle priggish, indeed. The solitary peccadillo, which she renounces on an early page with determination, and into which she does not relapse, is reading an interesting book when she ought to have been practising on the piano. Miss Maitland must remember that 'the low sun makes the colour,' and perfect Madge is not nearly so interesting as strong-willed, obstinate Leslie, the elder sister, with her warm heart struggling against a haughty temper. This is by far the best story for girls that we have seen this season. We shall hope to meet Miss Maitland in the same field again ere long.

The Boys of Raby. By F. A. White, B.A.

The author of this volume tells us, in a sentence extending over an entire page of his preface, that his hero is 'a perfect model of the quintessence of true heroism,' and that this book is 'a book, above all others, to be read by the fireside in every English home.' He adds that it will fill the heart of 'the uncontaminated boy' with 'all the radiance of a heaven of sweet, passionate love,' and that this same young gentleman will inevitably 'put it under his pillow, and dream of it.' For gorgeousness of self-puffery, the preface, at all events, is certainly unique; but the book is not one for serious criticism. We pity the 'uncontaminated boy' who shall dream of this story, just as we should pity the victim doomed to be roasted for the cannibal's table if he dreamt of a story of such a ghoul-like repast, for the 'Boys of Raby' get flogged on nearly every page. The author may be a satirist, and have written his detailed records of corporal punishment with a hidden intention of producing disgust at such a method of correction. If this be his idea, a little more attention to grammar would have aided the circulation of his book. It is difficult to distinguish the objective from the nominative in many sentences such as the following: '*He* stood with downcast eyes before the parson, slowly lugging the stolen fruit out of *his* pockets at *his* bidding, and laying it down at *his* feet in a basket, *he* feeling *him* the while, to make sure that *he* had kept none of it back, and at the same time cuttingly reminding the wretched criminal before *him* of the uncomfortable "quarter of an hour" of reckoning by-and-bye, when *he* would have to pay for it, wriggling, red-faced, and bellowing—a cut, a start, a scream for every stolen plum—under the rod *once more*.'

Biographical Stories. By Nathaniel Hawthorne.

This little book, which is illustrated with portraits, contains brief outlines of the careers of West the painter, Sir Isaac Newton, Dr. Johnson, Cromwell, Franklin, and Queen Christina of Sweden. The author's name is an assurance that they are written in a careful, cultivated literary style; but beyond that we may add that the language is simple, and of that bright, graphic kind suitable for young children. The biographies are supposed to be told to a boy suffering from temporary blindness. The little volume can be recommended for children from eight to thirteen years of age.

Sir Walter Raleigh. By F. L. Clarke.

This little volume is fairly well put together. There is no great vigour in the style, and the book would not be much more attractive to a young reader than his school lesson book for history. It is a mistake that there should be such long and frequent extracts from Kingsley's 'Westward Ho!' without any explanation being given to the young reader about the work which is being quoted. Even the name of the author of 'Westward Ho!' is not mentioned, and the young folks who are not learned in English literature will be apt to suppose that the volume in question must be some old historic record.

Life of Rachel, Lady Russell. By F. P. Guizot.

This little book is remarkably well written, and the well-known story of the life of Lady Russell is made most interesting. It is embellished with portraits of the heroine and her husband, and four other plates, and is dedicated by permission to the Duchess of Bedford. The tender affection between the husband and wife, and the display of public spirit and sound judgment, in combination with warm feelings, throughout Lady Russell's life, make its history instructive and impressive for all classes of readers

Birds and Their Ways. By Jessie F. Armstrong.

In this capital little book the birds are represented as each telling the story of its own manner of life, the food that it gathers, the nest that it builds, and the like. It is written with much ease and grace, and in an interesting manner. The little volume is profusely illustrated, and will form an acceptable gift-book for children of all ages.

Dr. Jolliffe's Boys: a Tale of Weston School. By Lewis Hough. London: Blackie and Son.

This is a capitally-written boy's book, handsomely bound and well illustrated, though we must confess to liking wood-cuts better than the new process by which these pictures are re-produced. Weston School is an establishment where lads over fourteen are prepared for Civil Service and Military examinations, and so on. The young fellows and the incidents of their school days are depicted with a vividness and an insight which make them really life-like. That momentous event, the first smoke, has been often described, but never more entertainingly than here. So with the cricket-match, the fight, and the first visit of the poorer boy to the wealthy one's home—these are all common incidents in boys' tales, but Mr. Hough's brilliant style of writing about them is anything but common-place. There are, too, many new things in the story; for instance, when poor Bullen goes out at night to skate, and is detected and mistaken for one of his schoolfellows who has been engaged in a poaching expedition. The tone of the work is good, and it can be warmly recommended as a gift-book for lads. The boy lucky enough to get it will read it with avidity, enjoy many a hearty laugh over it, and only regret that it is not twice the length.

A Waif of the Sea. By Kate Wood. London: Blackie and Sons.

This is a story about a little girl who sold flowers in some place called, 'The Strand;' but it cannot be the London Strand; that we know, because three flower-sellers and a lame boy in a perambulator are not allowed by the police to stand all day at street corners in that Strand. A tottery old gentleman, with plenty of money, knocks the little girl down by accident. He gives her half-a-crown, with which, of course, he intends her to replace her stock; but the little girl washes her flowers in the gutter in the Strand, where, strange to say, there must have been a quantity of clean water, although the day was so windy that old gentlemen could not keep their feet. She then proceeds to expend the half-crown, under the influence of a blarneying Irish shopkeeper, in butter, and bloaters, and tea, and sugar, and eggs. These she takes home, but they appear to be superfluous, since there was tea waiting for her on the table, and nice, 'spluttering sausages' to have with it. Moreover, there is a charitable male neighbour, once a soldier, now a cobbler, who, although he lives in a state of 'hard, grinding poverty,' nevertheless has 'roast pork with crackling and peas pudding' for dinner in sufficient quantities to give some away to the flower-girl's little sister at dinner-time, and to supply the flower-girl herself with some for supper, to fill up any vacuum that might remain after sausages for tea. Having experienced this fairy-land kind of poverty, the little flower-girl may be supposed not to have been readily surprised by any marvels that might occur in her future existence. Thus it does not astonish her, as it does the reader, when the old gentleman sends the whole family to a farm-house, and the old soldier's grinding poverty does not prevent him from going to see them safely established there; when he discovers the mistress of the farm-house to be his long-lost sister, and when the great lady of the neighbourhood turns out to be the flower-girl's long-lost mother. This sketch of the plot will probably suffice, and spare us from expressing any opinion upon this curious production, further than to remark that we wish the author's imagination had not led her into greater originality in other respects, than when she located her farm-house at Barnsbury, and half-drowned a character in the adjacent Ball's Pond.

1. **Wise Words and Loving Deeds.** By E. Conder Gray. Fourth Edition.
2. **Master Missionaries.** By Alexander Hay Japp, LL.D. New Edition.
3. **Labour and Victory.** By same Author. London: T. Fisher Unwin.

These three volumes consist of short biographies of remarkable women, missionaries, and others.

They are reprints, in some cases enlarged, of articles originally published in *Good Words*, *Sunday at Home*, and such magazines, which fact alone is sufficient guarantee that they are carefully prepared and well-written.

All the sketches in the first-mentioned volume are of remarkable women, and of how they triumphed over difficulties. The list comprises such names as Mary Somerville, Sarah Martin, Ann Taylor, Mary Carpenter, and Catherine Tait.

Madame Feller as the subject of a sketch is not so interesting. We cannot sympathise with those who become missionaries of one sect of Christianity to those of another. With all the heathen at home and abroad to bring into the folds of the Christian faith, Roman Catholics may very well be left alone. Such action on the part of any considerable section of a church is bound, not only to breed bad feeling between the churches, but also to be a handle to the enemies of religion. The sketch of Mary Carpenter is one of the happiest in the book.

In the second of these volumes, Dr. Japp has given us ten sketches. The subjects, except Dr. Moffat and Bishop Patterson, are not perhaps so well known as those of the other two volumes.

The third volume contains a longer account of Sir James Outram, as well as sketches of Bishop Selwyn, Thomas Davidson (Scottish probationer), Sir James Simpson, and others. The general reader will find the account of Bishop Selwyn particularly interesting.

The volumes may be said to be got up in prize form, being well printed and prettily bound.

Jack-o'-Lanthorn. By Henry Frith. London: Blackie and Son.

Jack was a sailor in charge of the lantern of a light-ship: hence his name. He and the young hero, who tells the story, are 'impressed' together, and presently find themselves engaged in the defence of Gibraltar—for the tale is laid in the last century. A very graphic description is given of the famous siege, in which Jack-o'-Lanthorn and his young comrade encounter dangers, and struggle through adventures, in fine style. No higher praise can be given to such a work than to say, as we fairly can, that it reads as though it were actually a record of things as they did happen. The life of a man-o'-war and of a besieged city are made real, with as much art and as close care for historical fact as used to mark the works of Kingston, whose style Mr. Frith's much resembles.

Allen's Patent Flexible Studs. London: K. Amery, High Street, Clapham.

Though these little articles lie somewhat out of our usual groove with respect to reviews, we have pleasure in saying of the set sent us that they display great ingenuity in the designing and making, and certainly merit commendation. The idea involved is the utilization of a flexible india-rubber stem instead of the usual rigid column of metal or bone to connect the head and base of the stud, and it is claimed that the elasticity and play thus gained will relieve the neck and wrists from the undue pressure caused by ordinary studs. We have no doubt whatever that experience will show this to be true, and venture to predict that these veritable bachelor's buttons will have a large sale amongst all those who have experienced the misery of a broken button-hole, and the difficulty of inserting an ordinary stud in a well-starched shirt front or cuff.

*** *Several reviews are unavoidably held over.*

Movements of Water.

No. I.—LESSON ON WAVES: WHAT THEY ARE AND WHAT THEY DO.

BY JOSEPH H. COWHAM, F.G.S.,
Normal Master, Wesleyan Training College, Westminster.

INFORMATION.

First Notion of Waves:—

Surfaces of water, like those of rivers ponds, lakes, and oceans, are rarely smooth. Winds blowing across these disturb their surfaces and form waves.

Kinds of Waves:—

(*a*) **Ripples** are formed on ponds and small lakes, also when a gentle breeze disturbs the sea. (Fig. 1).

(*b*) **Billows** are the larger waves, formed under the influence of a strong wind upon the surface of seas and oceans. (Fig. 1).

These reach a height of from 30 to 40 feet off the C. of Good Hope. In our narrow seas the highest waves are from 8 to 10 feet high.

(*c*) **Breakers** are formed when waves dash on a beach. (Fig. 1).

They are caused by the upper portion of a wave toppling over the lower portion. This lower portion is held back by friction against the shore. (Fig. 2).

Movements of Waves:—

The wave travels quickly over the surface. The particles of water are not carried forward with the wave, but simply rise and fall with each successive wave.

Note.—The terms *crest* and *trough* might be explained at this stage, and the class told that the length of a wave is taken from crest to crest.

Waves affect the surface only. The largest waves are not felt at depths greater than 200 feet.

Action of Breakers and Waves on the Land:—

(*a*) They wear away the edges of the land. This coast destruction is carried on within the vertical range between a point just above high water and a point a little below low water mark. (Fig. 5).

ILLUSTRATIONS AND TEACHING NOTES.

A boy may blow across a basin of water and form waves.

Appeal to the children's experience of waves formed by the wind at the seaside.

Fig. 1.

1. Ripples. 2. Billows. 3. Breakers.

These should be contrasted, and the places where each is generally found mentioned.

At B (Fig. 2) the water is held back. The top of the wave (A) falls over and forms the breaker.

Fig. 2.

(1) Illustrate by shaking a rope fastened at one end as in Fig. 3.

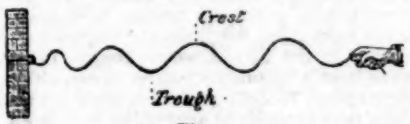
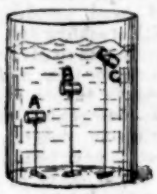


Fig. 3.

(2) If in the country, refer to wave motion over a field of corn.

(3) The boat riding over waves, and the cork floating over ripples, are movements due to this rising and falling of the particles of water.



Let A, B, and C (Fig. 4) represent three corks immersed at different depths. Then waves formed on the surface will be found to move only the corks near the surface.

Fig. 4.

Fig. 5.

A. High water. B. Low water.

(*b*) Where rocks of varying hardness are presented to the same breakers, the softer rocks yield first, and thus bays are scooped out. The harder rocks are left outstanding and form capes. (Fig. 6).

Fig. 6.

Between A and B (Fig. 6) are softer rocks, which the sea waves have scooped out, forming St. Bride's Bay.

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ **When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.**

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. PICKLES.—If I lay out £1911 in the purchase of 3 per cent. consols, when they are at 79⅛, at what price should I sell out my stock again in order to realise on the whole a gain of £150, after having paid ¼ per cent. for commission on each transaction? (*Barnard Smith.*)

$£79\tfrac{1}{8} + £\tfrac{1}{4} = £79\tfrac{3}{8}$;

$\therefore$ £ 79⅜ : £ 1911 :: 100 : amount of stock.

$$\frac{8}{317} \quad \frac{8}{1911} \quad \frac{}{24}$$

$= £2400.$

£ 1911 × 150

$$\frac{£}{8}\ \frac{£}{100} :: \frac{}{687} : \text{Amount received for £100 stock.}$$

$= £85\tfrac{7}{8}.$

$\therefore$ Selling price of stock $= £85\tfrac{7}{8} + \tfrac{1}{4}$

$= £86.$ Ans.

2. J. DAYSONETTE.—If 3 men, 5 women, *or* 8 children could do a piece of work in 26⅔ hours, in what time will 2 men, 3 women, *and* 4 children do it?

3 men can do as much as 8 children,

$\therefore$ 2 " " " $= \frac{8 \times 2}{3}$ children

$= 5\tfrac{1}{3}$ children;

5 women " " 8 children,

$\therefore$ 3 " " " $= \frac{8 \times 3}{5}$ children;

$= 4\tfrac{4}{5}$ children;

$\therefore$ 2 men, 3 women, and 4 children can do as much as $(5\tfrac{1}{3} + 4\tfrac{4}{5} + 4)$ children

$= 14\tfrac{2}{15}$ children;

children : children :: hrs. ; Time.

$$\frac{15}{112} \quad \frac{8}{2} \quad \frac{2}{8}$$

$= 1$ hour. Ans.

3. PUZZLED.—Determine the heaviest unit for which ·0064 ounce will be represented by an integer. (*Barnard Smith.*)

·0064 oz. = ·128 dwts. = 3·072 grs.

$= \frac{3072}{1000}$ grs. $= \frac{384}{125}$ grs.;

$\therefore$ Heaviest unit $= \frac{1}{125}$ gr. = ·008 gr. Ans.

4. VENTA BELGARUM.—The value of money increases from 4 to 5 per cent.; supposing this to have a corresponding influence on the funds, how much ought the 3 per cent. consols to sink?

$$\frac{£}{4} : 3 :: \frac{£}{100} : \text{Price of consols in 1st case.}$$

$= £75.$

$$\frac{£}{5} : 3 :: \frac{£}{100} : \text{Price of consols in 2nd case.}$$

$= £60.$

$\therefore$ Consols should fall from 75 to 60.

5. VENTA BELGARUM.—If £2843 7fr. 5c. be due from London to Paris when £1 is worth 25 francs, how much must be remitted when a guinea is worth 27 francs? (*Barnard Smith.*)

7fr. 5c. $= 7\tfrac{1}{20}$fr. $= \frac{7\frac{1}{20}}{25}£ = \frac{141}{500}£ = \frac{3}{10}£$;

£ 1 guinea : £ 1 francs : francs 27 :: £ 2843·3 : Amount to be remitted.

$$= \frac{28433 \times \overset{7}{\cancel{21}} \times \overset{8}{\cancel{24}}}{\underset{2}{\cancel{100}} \times \underset{4}{\cancel{25}} \times \underset{9}{\cancel{27}}}£$$

$= \frac{199031}{72}£$

$= £2764\tfrac{23}{72}$;

$£\tfrac{23}{72} = \frac{23 \times \overset{8}{\cancel{24}} \times \overset{7}{\cancel{21}}}{\underset{8}{\cancel{72}} \times \underset{7}{\cancel{21}}}$ francs $= \frac{161}{72}$ francs

$= 8\tfrac{5}{72}$ fr. $= 8{\cdot}2142857$ fr.

$= 8$fr. $2{\cdot}142857$c.;

$\therefore$ Amount = [illegible] ·142857c. Ans.

6. SOUTH WALIAN.—How much must a $3\frac{1}{2}$ per cent. stock fall below par, in order that a broker, after charging $\frac{1}{8}$ per cent. fees, may get me $4\frac{1}{4}$ per cent. interest for my money? (*Pupil Teachers' Exam.*, February, 1879.)

£ £ £
$4\frac{1}{4} : 3\frac{1}{2} :: 100$: Price of stock with brokerage.

$\frac{4}{19} \mid \frac{4}{1400}$

$£73\frac{13}{19}$

Price of stock without brokerage $= £73\frac{13}{19} - £\frac{1}{8}$
$= £73\frac{104-19}{152}$
$= £73\frac{85}{152}$;
∴ The stock must fall $(100 - 73\frac{85}{152})$ below par
$= 26\frac{67}{152}$ below par. Ans.

7. G. C. OUTHWAITE.—A gentleman, deriving all his income from a railway investment paying 4 per cent. on his capital, spends $\frac{7}{8}$ of his income on personal expenses, and pays an income tax of 6d. in the pound; next year the railway dividends are $4\frac{1}{2}$ per cent., his personal expenses 10 per cent. more, the income tax is reduced to 4d. in the £, and he finds that he is £5 richer. What was his original income? (*Snaith's* 'Examination Arithmetic.')

Amount saved 1st year out of an income of £4
$= £4 - \{\frac{7}{8}$ of £4 + (6d. × 4)$\}$
$= £4 - (£2$ 13s. 4d. + 2s.)
$= £1$ 4s. 8d.;
Amount saved 2nd year out of an income of $£4\frac{1}{2}$
$= £4\frac{1}{2} - \{(£2$ 13s. 4d. + $\frac{1}{10}$ of £2 13s. 4d.)
$+ (4d. \times 4\frac{1}{2})\}$
$= £4\frac{1}{2} - (£2$ 13s. 4d. + 5s. 4d. + 1s. 5d.)
$= £4$ 5s. − £3 0s. 1d.
$= £1$ 4s. 11d.;
Difference between the amounts saved
$= £1$ 4s. 11d. − £1 4s. 8d.
$= 3$d.;
d. £ £
∴ 3 : 5 :: 4 : Original Income.
$= £(5 \times 80 \times 4)$
$= £1600$. Ans.

8. J. A S.—The product of three numbers is $3057\frac{133}{216}$; the greatest of them is $17\frac{3}{4}$; and of the others, the greater is not more than $3\frac{1}{16}$ of the other, nor less than $2\frac{1}{4}$ of it: find the limits within which the least must be. (*Examination for Lower Division Clerkships*, October, 1883.)

Product of second and least numbers
$= 3057\frac{133}{216} \div 17\frac{3}{4}$
$= \frac{660477}{216} \div \frac{71}{4}$
11025
$= \frac{\cancel{660477}}{\cancel{216}} \times \frac{\cancel{4}}{\cancel{71}}$
64
$= 11\frac{9}{64}$;
If second No. were $3\frac{1}{16}$ of least No.,
Then, least No. × $3\frac{1}{16}$ of least No. would equal $11\frac{9}{64}$,
Least No. × least No. would equal $11\frac{9}{64} \div 3\frac{1}{16}$
225
$= \frac{\cancel{721}}{\cancel{64}} \times \frac{\cancel{16}}{\cancel{49}}$
4
$= 2\frac{25}{4}$,
∴ Least No. would equal $\sqrt{2\frac{25}{4}}$
$= \frac{15}{4}$
$= 7\frac{1}{2}$.

If second No. were $2\frac{1}{4}$ of least No.,
Then, least No. × $2\frac{1}{4}$ of least No. would equal $11\frac{9}{64}$,
Least No. × least No. would equal $11\frac{9}{64} \div 2\frac{1}{4}$
1225
$= \frac{\cancel{721}}{\cancel{64}} \times \frac{\cancel{4}}{\cancel{9}}$
16
$= 1\frac{225}{64}$,
∴ Least No. would equal $\sqrt{1\frac{225}{64}}$
$= \frac{25}{8}$
$= 8\frac{1}{2}$.

∴ Limits of least number are $8\frac{1}{2}$ and $7\frac{1}{2}$.

9. ESSEX.—Simplify:—

$$\frac{\frac{1}{7} + 1\frac{3}{4} + \frac{2}{5} \div \frac{1}{3} - \frac{1}{7}}{3}.$$

$$\frac{\frac{1}{7} + 1\frac{3}{4} + \frac{2}{5} \div \frac{1}{3} - \frac{1}{7}}{3}$$

$$= \frac{\frac{1}{7} + 1\frac{3}{4} + \frac{2}{5} \div \frac{7-2}{14}}{\frac{3}{1}}$$

$$= \frac{\frac{1}{7} + 1\frac{3}{4} + \frac{2}{5} \div \frac{5}{14}}{\frac{3}{1}}$$

$$= \frac{\frac{1}{7} + 1\frac{3}{4} + \frac{2}{5} \div \frac{5}{14}}{3}$$
$= \frac{1}{7} + 1\frac{3}{4} + \frac{2}{5} \times \frac{14}{5}$
$= \frac{1}{7} + 1\frac{3}{4} + \frac{28}{25}$
$= \frac{1}{7} + 1\frac{3}{4} + 3\frac{3}{25}$
$= 4 + \frac{100 + 525 + 252}{700}$
$= 4 + \frac{877}{700}$
$= 4 + 1\frac{177}{700}$
$= 5\frac{177}{700}$. Ans.

10. AMBITIOUS.—Of three taps A can fill a cistern in 24 minutes, B in 10 minutes, and C in 27 minutes. All three are turned on, and after $4\frac{1}{2}$ minutes, B and C are turned off. In what time will A finish filling the cistern by itself?—(*Johnston's* 'Civil Service Examination Papers.')

A can fill the cistern in 24 minutes,
B " " " 10 " ,
C " " " 27 " ;
∴ A " in 1 minute $\frac{1}{24}$ of the cistern,
B " " " $\frac{1}{10}$ " ,
C " " " $\frac{1}{27}$ " ;
∴ A, B, and C can fill in 1 min. $\frac{1}{24} + \frac{1}{10} + \frac{1}{27}$ of the cistern
$= \frac{45 + 108 + 40}{1080}$ of the cistern
$= \frac{193}{1080}$ of the cistern,
Part filled by A, B, and C in $4\frac{1}{2}$ min. $= \frac{193}{1080} \times 4\frac{1}{2}$
$= \frac{\cancel{193}}{\cancel{240}} \times \frac{\cancel{9}}{2}$
120
$= \frac{193}{240}$,
∴ Part remaining $= 1 - \frac{193}{240}$
$= \frac{47}{240}$;
∴ A can finish filling the cistern in $(\frac{47}{240} \div \frac{1}{24})$ min.
$= \left(\frac{47}{\cancel{240}} \times \frac{\cancel{24}}{1}\right)$ min.
10
$= 4\frac{7}{10}$ min. Ans.

Note.—Your writing might obtain 90 per cent. of marks.

11. J. EDWARDS.—A starts to walk from one town to another at the average rate of 3 miles an hour; 40 minutes later a bicyclist B starts on the same journey at the rate of 12 miles an hour. On reaching the second town B rests half an hour, and after riding 40 minutes on his return journey meets A still on his way. Find the distance between the two towns. (*Female Clerks*, Sept., 1882.) (To be solved by arithmetic.)

Distance gone by B in 40 min. $= \frac{2}{3}$ of 12 miles
$= 8$ miles;
∴ A is 8 miles from second town when B meets him;
B goes that distance in $(\frac{2}{3} + \frac{1}{2} + \frac{1}{2} + \frac{2}{3})$ hrs. less than A,
$= 2\frac{1}{2}$ hrs. less than A;
A goes 1 mile in $\frac{1}{3}$ hour,
B " " $\frac{1}{12}$ " ,
Difference in going 1 mile $= (\frac{1}{3} - \frac{1}{12})$ hr.
$= \frac{1}{4}$ hr.;
∴ Distance gone by A when B meets him
$= (2\frac{1}{2} \div \frac{1}{4})$ miles
2
$= \left(\frac{5}{\cancel{2}} \times \frac{\cancel{4}}{1}\right)$ miles
$= 10$ miles;
∴ Distance between the two towns $= (10 + 8)$ miles
$= 18$ miles. Ans.

(See answer to 'Odd Eyes' in Algebra.)

Note.—English Composition (*Macmillan's* 'Primers'), price 1s.

12. IGNORAMUS.—If I am allowed $1\frac{1}{2}$ per cent. discount on an amount charged to me for goods, and give my acceptance for five months for the nett sum, and if by selling the goods forth-

with for a bill of £162 12s. 2d., payable in 7 months, my present gain is $11\frac{1}{9}$ per cent.; what is the amount originally charged to me, interest being reckoned at 5 per cent. per annum?—(*Colenso.*)

$\frac{7}{12}$ of £5 = £$2\frac{11}{12}$;

	£		£	s.	d.		£	
∴	$102\frac{11}{12}$	:	162	12	2	::	100	: Present value of the bill.
	12				12		20	
	1235		1951	6	0			
	247			20				

)39026 0 0(£158
247
1432
1235
1976
1976

	£		£		£	
∴	$111\frac{1}{9}$	:	158	::	100	: Present value of the acceptance.
	9		9			
	1000		1422			

= £142 4s.

∴ Amount of the acceptance

= £142 4s. + interest on £142 4s.
= £142 4s. + $\frac{7}{12}$ of 5% on £142 4s.
= £142 4s. + $\frac{5}{12}$ of $\frac{1}{20}$ of £142 4s.
= £142 4s. + $\frac{1}{48}$ of £142 4s.
= £142 4s. + £2 19s. 3d.
= £145 3s. 3d.

£		£	s.	d.		£	
100							
$1\frac{1}{4}$							
$98\frac{3}{4}$	:	145	3	3	::	100	: Original amount.
4				4		20	
395		580	13	0			
79			20				

)11613 0 0(£147. Ans.
79
371
316
553
553

Algebra.

1. SABINUS.—Resolve the following expressions into factors (with rules fully explained):—

(1) $2(x+y)^2 - 7(x+y)(a+b) + 3(a+b)^2$;
(2) $x^2 - 13xy + 42y^2$.

(1) $2(x+y)^2 - 7(x+y)(a+b) + 3(a+b)^2$;

It is evident that the first terms of the factors will be $2(x+y)$ and $(x+y)$, and that the second terms will be $3(a+b)$ and $(a+b)$.

As the coefficient of the middle term is 7, it is evident that $2(x+y)$ and $3(a+b)$ will not be in the same factor, as $7=(2\times 3)+1$; and as the middle term has the *minus* and the third term has the *plus* sign, both factors will have the second term *minus*.

$$\therefore\ 2(x+y)^2 - 7(x+y)(a+b) + 3(a+b)^2 = \{2(x+y)-(a+b)\}\{(x+y)-3(a+b)\}.$$

(2) $x^2 - 13xy + 42y^2$;

Let a and b = the coefficients of the second terms of the factors;

Then, (1) $a+b=-13$, (2) $ab=42$

(1) Squared: $a^2+2ab+b^2=169$
(2) ×4: $4ab = 168$
Subtracting, $a^2-2ab+b^2 = 1$
Extracting square root: $a-b=\pm 1$; (1) $a+b=-13$

$\therefore a=-6$ or -7, and $b=-7$ or -6.

$$\therefore x^2-13xy+42y^2 = \underline{(x-7y)(x-6y)}.$$

2. P. P.—Multiply together:—

$$x^2-(b-c)x-bc,\ x^2-(c-a)x-ca,\ x^2-(a-b)x-ab;$$

and divide the result by

$$x^3-(a+b+c)x^2+(bc+ca+ab)x-abc.$$

(*Intermediate Arts*, 1883.)

$$\{x^2-(b-c)x-bc\}\{x^2-(c-a)x-ca\}$$
$$=x^4-(c-a)x^3-(b-c)x^3-acx^2-bcx^2+(b-c)(c-a)x^2+bc(c-a)x+ac(b-c)x+abc^2$$
$$=x^4+(a-b)x^3-(ab+c^2)x^2-c^2(a-b)x+abc^2;$$
$$\{x^4+(a-b)x^3-(ab+c^2)x^2-c^2(a-b)x+abc^2\}\{x^2-(a-b)x-ab\}$$
$$=x^6+(a-b)x^5-(a-b)x^5-(ab+c^2)x^4-(a-b)(a-b)x^4-abx^4-c^2(a-b)x^3+(a-b)(ab+c^2)x^3-ab(a-b)x^3+abc^2x^2+c^2(a-b)^2x^2+ab(ab+c^2)x^2-abc^2(a-b)x+abc^2(a-b)x-a^2b^2c^2$$
$$=x^6-(a^2+b^2+c^2)x^4+(a^2b^2+a^2c^2+b^2c^2)x^2-a^2b^2c^2.$$

$x^3-(a+b+c)x^2+(ab+ac+bc)x-abc)\ x^6-(a^2+b^2+c^2)x^4+(a^2b^2+a^2c^2+b^2c^2)x^2-a^2b^2c^2\ (x^3+(a+b+c)x^2+(ab+ac+bc)x+abc$

$$x^6-(a+b+c)x^5+(ab+ac+bc)x^4-abcx^3$$
$$(a+b+c)x^5-(a^2+b^2+c^2+ab+ac+bc)x^4+abcx^3+(a^2b^2+a^2c^2+b^2c^2)x^2-a^2b^2c^2$$
$$(a+b+c)x^5-(a^2+b^2+c^2+2ab+2ac+bc)x^4+(a+b+c)(ab+ac+bc)x^3-abc(a+b+c)x^2$$
$$(ab+ac+bc)x^4-\{(a+b+c)(ab+ac+bc)-abc\}x^3+(a^2b^2+a^2c^2+b^2c^2+a^2bc+ab^2c+abc^2)x^2-a^2b^2c^2$$
$$(ab+ac+bc)x^4-(a+b+c)(ab+ac+bc)x^3+(a^2b^2+a^2c^2+b^2c^2+2a^2bc+2ab^2c+2abc^2)x^2-abc(ab+ac+bc)x$$
$$abcx^3-abc(a+b+c)x^2+abc(ab+ac+bc)x-a^2b^2c^2$$
$$abcx^3-abc(a+b+c)x^2+abc(ab+ac+bc)x-a^2b^2c^2$$

$$\therefore \text{Quotient} = \underline{x^3+(a+b+c)x^2+(ab+ac+bc)x+abc.}$$

3. ODD EYES.—A starts to walk from one town to another at the average rate of 3 miles an hour; 40 minutes later a bicyclist, B, starts on the same journey at the rate of 12 miles an

hour. On reaching the second town B rests half-an-hour, and after riding 40 minutes on his return journey meets A, still on his way. Find the distance between the two towns.

Distance gone by B in 40 minutes $= \frac{2}{3}$ of 12 miles
$= 8$ miles;

Let x = Distance between the towns in miles;

Then, $\frac{x}{12} + \left(\frac{2}{3} + \frac{1}{2} + \frac{2}{3}\right) = \frac{x-8}{3}$

$\frac{x}{12} + \frac{11}{6} = \frac{x-8}{3}$

$x + 22 = 4x - 32$

$4x - x = 22 + 32$

$3x = 54$

$\therefore x = 18.$

$\therefore$ Distance between the towns = 18 miles. Ans.

4. G. NEWLYN.—Solve :—

$$\frac{1}{x-1} - \frac{2}{x-2} = \frac{3}{x-3} - \frac{4}{x-4}. \quad (\textit{Scholar.})$$

$$\frac{1}{x-1} - \frac{2}{x-2} = \frac{3}{x-3} - \frac{4}{x-4}$$

$$\frac{x-2-2(x-1)}{(x-1)(x-2)} = \frac{3(x-4)-4(x-3)}{(x-3)(x-4}$$

$$\frac{x-2-2x+2}{(x-1)(x-2)} = \frac{3x-12-4x+12}{(x-3)(x-4)}$$

$$\frac{-x}{(x-1)(x-2)} = \frac{-x}{(x-3)(x-4)}$$

Dividing each side by $-x$:

$$\frac{1}{(x-1)(x-2)} = \frac{1}{(x-3)(x-4)}$$

$(x-1)(x-2) = (x-3)(x-4)$

$x^2 - 3x + 2 = x^2 - 7x + 12$

$7x - 3x = 12 - 2$

$4x = 10$

$\therefore x = 2\frac{1}{2}.$

As we divided by x, we put $x = 0$.

$\therefore x = 0$, or $2\frac{1}{2}$.

Note.—The equation $4x^2 - 10x = 0$, by dividing by x, is reduced to a simple equation.

5. A. C. A.—Solve :—

$$\left.\begin{aligned} &(1)\ \frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1 \\ &(2)\ \frac{x}{a} + \frac{y}{c} + \frac{z}{b} = 1 \\ &(3)\ \frac{x}{b} + \frac{y}{a} + \frac{z}{c} = 1 \end{aligned}\right\} (\textit{Todhunter.})$$

$$\left.\begin{aligned} &(1)\ \frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1 \\ &(2)\ \frac{x}{a} + \frac{y}{c} + \frac{z}{b} = 1 \\ &(3)\ \frac{x}{b} + \frac{y}{a} + \frac{z}{c} = 1 \end{aligned}\right\}$$

$$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = \frac{x}{a} + \frac{y}{c} + \frac{z}{b}$$

$$\frac{y}{b} + \frac{z}{c} = \frac{y}{c} + \frac{z}{b}$$

$$\frac{y}{b} - \frac{y}{c} = \frac{z}{b} - \frac{z}{c}$$

$\therefore y = z.$

$$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = \frac{x}{b} + \frac{y}{a} + \frac{z}{c}$$

$$\frac{x}{a} + \frac{y}{b} = \frac{x}{b} + \frac{y}{a}$$

$$\frac{x}{a} - \frac{x}{b} = \frac{y}{a} - \frac{y}{b}$$

$\therefore x = y.$

(1) $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$

$\therefore \frac{x}{a} + \frac{x}{b} + \frac{x}{c} = 1$

$(bc + ac + ab)x = abc$

$\therefore x = \frac{abc}{ab + ac + bc}.$

$\therefore x = y = z = \frac{abc}{ab + ac + bc}.$

6. H. T.—Solve :—

$$\left.\begin{aligned} &x^3 + y^3 = 31 \\ &x^2 + y^2 = 17 \end{aligned}\right\}$$

$$\left.\begin{aligned} &(1)\ x^3 + y^3 = 31 \\ &(2)\ x^2 + y^2 = 17 \end{aligned}\right\}$$

Subtracting, $x^3 - x^2 + y^3 - y^2 = 14$

$(x^3 - y^3) - (x^2 - y^2) = 14$

$(x-y)(x^2 + xy + y^2) - (x-y)(x+y) = 14$

$(x-y)\{x^2 + xy + y^2 - (x+y)\} = 14$

$(x-y)(x^2 + xy + y^2 - x - y) = 14$

$= 1 \times 14,$

or 2×7, etc.

Take, (1) $x - y = 1$

Then, (2) $x^2 + xy + y^2 - x - y = 14$

$\therefore$ (1) $y = x - 1$

(2) $x^2 + x(x-1) + (x-1)^2 - x - (x-1) = 14$

$x^2 + x^2 - x + x^2 - 2x + 1 - x - x + 1 = 14$

$3x^2 - 5x = 14 - 2$

$= 12$

$x^2 - \frac{5x}{3} = 4$

$x^2 - \frac{5x}{3} + \left(\frac{5}{6}\right)^2 = 4 + \frac{25}{36}$

$= \frac{144+25}{36}$

$x - \frac{5}{6} = \pm\frac{13}{6}$

$x = \pm\frac{13}{6} + \frac{5}{6}$

$\therefore x = 3$, or $-\frac{4}{3}$

$y = x - 1$

$= 3 - 1$, or $-\frac{4}{3} - 1$

$= 2$, or $-\frac{7}{3}$.

The negative values of x and y do not satisfy the equations.

By taking, $x - y = 2$ and $x^2 + xy + y^2 - x - y = 7$, we obtain surd values of x and y respectively.

The integral values of x and y are $x = 3$ and $y = 2$

7. R. H. L.—A man walks from A to B at a certain rate: if he had walked half a mile an hour faster, he would have walked the distance in 9 hours less; if a mile per hour faster, in 16 hours less; find the distance from A to B. (*Certificate Exam.*, 1880.)

Let x = distance between A and B in miles,

And y = his rate per hour in miles;

Then, $\left.\begin{aligned} &(1)\ \frac{x}{y + \frac{1}{2}} = \frac{x}{y} - 9 \\ &(2)\ \frac{x}{y+1} = \frac{x}{y} - 16 \end{aligned}\right\}$

$$\left.\begin{aligned} &(1)\ \frac{2x}{2y+1} = \frac{x}{y} - 9 \\ &(2)\ \frac{x}{y+1} = \frac{x}{y} - 16 \end{aligned}\right\}$$

$$\left.\begin{aligned} &(1)\ 2xy = x(2y+1) - 9y(2y+1) \\ &(2)\ xy = x(y+1) - 16y(y+1) \end{aligned}\right\}$$

$$\left.\begin{aligned} &(1)\ 2xy = 2xy + x - 9y(2y+1) \\ &(2)\ xy = xy + x - 16y(y+1) \end{aligned}\right\}$$

$$\left.\begin{aligned} &(1)\ x = 9y(2y+1) \\ &(2)\ x = 16y(y+1) \end{aligned}\right\}$$

$\therefore 9y(2y+1) = 16y(y+1)$

$9(2y+1) = 16(y+1)$

$18y + 9 = 16y + 16$

$18y - 16y = 16 - 9$

$2y = 7$

$\therefore y = 3\frac{1}{2}.$

(1) $x = 9y(2y+1)$

$= 9 \times 3\frac{1}{2}\{(3\frac{1}{2} \times 2) + 1\}$

$= \frac{63}{2} \times 8$

$= 252.$

$\therefore$ Distance from A to B = 252 miles.

8. INQUISITIVE.—Solve :—

$$\left.\begin{aligned} &\frac{x}{yz} = a \\ &\frac{y}{zx} = b \\ &\frac{z}{xy} = c \end{aligned}\right\} (\textit{Edinburgh University, Higher Algebra, 1883-4.})$$

$$\left.\begin{array}{l}(1)\ \frac{x}{yz}=a\\(2)\ \frac{y}{zx}=b\\(3)\ \frac{z}{xy}=c\end{array}\right\}$$

Multiplying these together,

$$\frac{1}{xyz}=abc$$

$$xyz=\frac{1}{abc}$$

$$\therefore\ yz=\frac{1}{abcx}$$
$$xz=\frac{1}{abcy}$$
$$xy=\frac{1}{abcz}$$

$$(1)\ \frac{x}{yz}=a$$
$$x=ayz$$
$$=\frac{a}{abcx}$$
$$x^2=\frac{1}{bc}$$
$$\therefore\ x=\pm\frac{1}{\sqrt{bc}}$$

$$(2)\ \frac{y}{xz}=b$$
$$y=bxz$$
$$=\frac{b}{abcy}$$
$$y^2=\frac{1}{ac}$$
$$\therefore\ y=\pm\frac{1}{\sqrt{ac}}$$

$$(3)\ \frac{x}{xy}=c$$
$$z=cxy$$
$$=\frac{c}{abcz}$$
$$z^2=\frac{1}{ab}$$
$$\therefore\ z=\pm\frac{1}{\sqrt{ab}}$$

$$x=\pm\frac{1}{\sqrt{bc}},\ y=\pm\frac{1}{\sqrt{ac}},\ \text{and}\ z=\pm\frac{1}{\sqrt{ab}}$$

9. DENNY, Leamington.—A person walking at a given rate (a) along a road parallel to a railway is overtaken and met by two trains, travelling at given rates (r_1 and r_2), and he observes that the time each takes is the same. Compare the lengths of the trains. (*Hamblin Smith.*)

Taking the rates in miles per hour,

Time it takes 1st train to pass him

$$=\frac{\text{Length of 1st train in miles}}{(r_1-a)\text{ miles}}\ \text{of an hour,}$$

Time it takes 2nd train to pass him

$$=\frac{\text{Length of 2nd train in miles}}{(r_2+a)\text{ miles}}\ \text{of an hour;}$$

$$\therefore\ \frac{\text{Length of 1st train in miles}}{(r_1-a)\text{ miles}}\ \text{of an hour}=\frac{\text{Length of 2nd train in miles}}{(r_2+a)\text{ miles}}\ \text{of an hour,}$$

$$\frac{\text{Length of 1st train in miles}}{(r_1-a)\text{ miles}}=\frac{\text{Length of 2nd train in miles}}{(r_2+a)\text{ miles}}$$

$$\therefore\ \text{Length of 1st train in miles : Length of 2nd train in miles} :: (r_1-a)\text{ miles} : (r_2+a)\text{ miles,}$$

$$\therefore\ \text{Length of 1st train : Length of 2nd train} :: r_1-a : r_2+a.$$

Mensuration.

1. J. DAYSONETTE.—Find the cost of carpeting a room 27 ft. long, 16 ft. 6 in. wide, with border all round of $\frac{2}{3}$ yd. wide at 3s. 6d. a yard, and inside border, plain carpet of $\frac{3}{4}$ yd. wide at 5s. a yard.

Area of floor $=27\text{ ft.}\times16\tfrac{1}{2}\text{ ft.}$

$$=\left(\frac{27}{1}\times\frac{33}{2}\times\frac{1}{9}\right)\text{sq. yds.}$$
$$=\tfrac{99}{2}\text{ sq. yds.}$$

Area of border $=\{27\text{ ft.}+16\tfrac{1}{2}\text{ ft.}-(\tfrac{2}{3}\text{yd.}\times2)\}\times\tfrac{2}{3}\text{ yd.}\times2$
$=\{9\text{ yds.}+5\tfrac{1}{2}\text{ yds.}-\tfrac{4}{3}\text{ yd.}\}\times\tfrac{2}{3}\text{ yd.}$
$=13\tfrac{1}{6}\text{ yds.}\times\tfrac{2}{3}\text{ yd.}$
$$=\left(\frac{55}{4}\times\frac{3}{4}\right)\text{sq. yds.}$$
$$=\tfrac{165}{16}\text{sq. yds.;}$$

Area of floor without border $=(\tfrac{99}{2}-\tfrac{165}{16})$ sq. yds.
$$=\frac{792-165}{16}\text{ sq. yds.}$$
$$=\tfrac{627}{16}\text{ sq. yds.;}$$

Quantity of carpet required for border
$=\{27\text{ ft.}+16\tfrac{1}{2}\text{ ft.}-(\tfrac{2}{3}\text{ yd.}\times2)\}\times2$
$=27\tfrac{2}{3}\text{ yds.;}$

Quantity of carpet required for floor inside border
$=\tfrac{627}{16}$ sq. yds. $\div\tfrac{3}{4}$ yd.
$$=\left(\frac{\cancel{627}}{\cancel{16}}\times\frac{\cancel{4}}{\cancel{3}}\right)\text{ yds.}$$
$$=52\tfrac{3}{4}\text{ yds.;}$$

$\therefore$ Total cost of carpet $=(3\text{s. }6\text{d.}\times27\tfrac{2}{3})+(5\text{s.}\times52\tfrac{3}{4})$
$=£4\ 16\text{s. }3\text{d.}+£13\ 1\text{s. }3\text{d.}$
$=£17\ 17\text{s. }6\text{d.}$ Ans.

Geometry.

1. DOUBTFUL.—If a, b, c, d represent the lengths of four given right lines, construct the square whose area is represented by $\sqrt{abcd}$. (*Intermediate Arts*, 1883.)

Construct a rectangle with sides equal to a and b respectively;
Make a square equal to this rectangle; (II. 14.)
The area of this square is represented by ab;
$\therefore$ The side of this square is represented by $\sqrt{abcd}$.
Let e represent the length of the side of this square.
Again, construct a rectangle with sides equal to c and d respectively;
Make a square equal to this rectangle; (II. 14.)
The area of this square is represented by cd;
$\therefore$ The side of this square is represented by $\sqrt{cd}$;
Let f represent the length of the side of this square.
Now, construct a rectangle with sides equal to e and f respectively;
Make a square equal to this rectangle; (II. 14.)
The area of this square is represented by ef, that is by

$$\sqrt{ab}\times\sqrt{cd}\ \sqrt{abcd}.$$ Q. E. F.

General.

1. NANCE.—When a man is choked, the veins leading from the neck and head into the right side of the heart are compressed, and the blood in them, which is dark and venous, is retained in the neck and head, causing the dark, livid, or even black appearance of choking.

2. BLUE RIBBON'S extracts of blank verse are very blank. There is no evidence of poetry in them. The formal arrangement of lines of an equal number of syllables in rhythmic order does not of itself constitute a poem. B. R.'s impression that 'they read rather peculiar' may be due to the absence of the poetic spirit, or to great irregularity in the rhythm.

3. A TEACHER would get good marks for his writing, but there is still room for improvement. The capitals need special attention, and the proportions of the letters need to be *studied*.

4. A. I. O. S.—'What is done must be done well,' consists of *two* sentences: *What is done* is a noun sentence and subject of *must be done*; *well* is the adv. extension. There is no adjective sentence here.

5. DISCIPULUS may write for a catalogue to Messrs. Crosby and Lockwood, London, who publish many Civil Service manuals. We cannot say which is the '*best*' book on the subject named.

6. W. A. DAVIES is referred to *Morris's* or *Daniel's* 'Grammar' (last part). The National Society's works on School Management (Teaching) will help you, but we know of no notes of lessons that come up to our ideal. *Find later's* 'Physical Geography' is a good book.

7. WELLINGTON'S writing is very neat. If the capitals were equally good he might get 85 or 90 per cent.

8. W. H. CHOULER'S certificate can be raised by examination only; but he cannot sit again until Christmas, 1884. Service in the meantime is not a necessary condition to obtaining a seat.

9. OBJECT.—We regret to say that we cannot insert your query owing to the great space it would occupy.

10. LOTHIAN.—In *all* self-testing sums the questions are constructed from the answers.

11. JAS. M'GABRIEL.—The essay is not devoid of merit, but is written in too ambitious a style, and contains several grammatical errors. The handwriting is very good, and would gain about ninety per cent.

12. EXCELSIOR.—Extra pay is awarded only for extra duty. Night duty may be assigned to special officers.

13. A. H. M.—Write to the agent for Queensland (or any Australian colony), Victoria Street, Westminster.

14. JESSOP can take the Scholarship Examination as a P. T. if his name appears on the recognised staff of the school to which he was transferred. It is not now too late to note the transference on the indentures.

15. SIBELLA can raise her certificate by service only if, as we understand, she is now in the second class. (See Code as to classification of Certificates.) If, however, she is in the third class, she must wait at least two years (until 1885), when she can raise it only by taking the Second Year's Papers.

16. PALESTINE will see in the P. T.'s schedule what science subjects count in the Q. S. Examination. Answers to some of the last Q. S. Questions (1883) will be published in our own columns. There is no *complete* collection known to us. The 'papers' of the Education Department have the questions printed at intervals on the margin of each of two or four pages of a large sheet, ruled to contain the answers.

17. M. T. C.—Your query was solved in our issue for March, 1883.

18. A CHURCHMAN can obtain full information as to the Religious Knowledge Examinations of the National Society from the Rev. J. Menet, M.A., Hockerile, Bishop's Stortford.

19. SCOTSMAN.—In all probability you may find a translation among the Bohn Series. We do not know of any grammar of the language. Messrs. Trubner and Co., of Ludgate Hill, publish books in many of the oriental languages. They may be able to give you some information if you write to them.

20. DISSATISFIED.—Think well before you emigrate. If you have a trade to fall back upon, all the better. With respect to capital, you ask a very difficult question. What one man would think ample, another would consider far below what was needful. A great deal depends, too, upon the line of business in which you intend to embark.

21. FRED C. S.—Either *Ganot's* or *Dechanel's* 'Physics' will give you all the information you require. You can obtain them through any bookseller.

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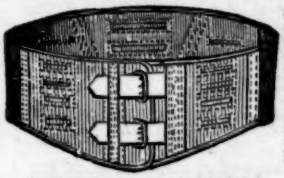

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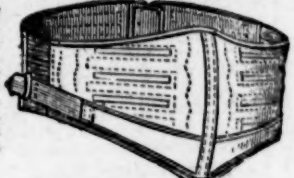

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